PHYSIOLOGY, FIRST AID AND NAVAL HYGIENE

—HEINER

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A TEXT BOOK FOR THE DEPARTMENT OF
NAVAL HYGIENE AND PHYSIOLOGY
AT THE U. S. NAVAL ACADEMY
ANNAPOLIS, MARYLAND

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PREFACE.

This short syllabus is intended to help in following the lectures and taking notes in a course of physiology and hygiene, which is required by a law passed by Congress in 1886. The law was passed through the efforts of Mrs. Mary Hunt, of Boston, and requires that the evil effects of alcohol and narcotics be made a part of the instruction.

A knowledge of the rudiments of hygiene, physiology and first-aid is necessary to every naval officer. Sooner or later each one of them is likely to find himself in charge of a small detachment of men at some isolated station where there is no doctor, and it will devolve upon him to make the necessary arrangements for the preservation of the health of his men, to treat their injuries and diseases, and see that their efficiency is not undermined by sickness. In order that he may do this intelligently it is necessary for him to know something about the structure and workings of the human body.

My obligations to the standard text books of the day are hereby acknowledged, and I also here express my thanks to Hospital Steward A. K. Snyder for his most valuable assistance. In the chapter on alcohol and other narcotics I have freely consulted articles on the subject by Lieut. Colonel Frank R. Keefer, Medical Corps, U. S. A.; Dr. Leslie E. Keeley and others.

R. G. HEINER.

A BRIEF ABSTRACT OF

ANATOMY, PHYSIOLOGY, HYGIENE AND FIRST-AID FOR USE IN CONJUNCTION WITH NOTES TAKEN FROM LECTURES ON SAME TO THE FIRST CLASS OF MIDSHIPMEN AT THE NAVAL ACADEMY

CONTENTS.

CHAPTER I.

MINUTE ANATOMY OR HISTOLOGY AND CELL PHYSIOLOGY.

Everything in this world that occupies space can be divided or classed under two headings; it is either organic or inorganic matter.

In your studies in physics and chemistry here at the Naval Academy you have been dealing nearly altogether with inorganic matter, as, air, water, steel, iron, etc. You have learned their properties and you have studied the laws that govern them. You have also studied the various forms of energy, their sources and their interconvertibility one into the other. You know the laws of conservation of matter and the laws of conservation of energy. You know that matter is indestructible, that energy exists, never increases or diminishes, that it is always present in conjunction with matter either in kinetic or potential form. You know that all energy, whether it be heat, light, electricity or mechanical, must have a source.

We do not know what matter is, we do not know what energy is and we do not know what life is, but we can say without matter and energy no life can exist. Living bodies live by reason of the energy they consume; and living or dead, they are composed of matter. The same elements which form coal and air and water enter into their composition, and the same elements which by combining, as oxygen and carbon for example, release their potential energy in the form of heat in the fire-box under a boiler to produce steam, release their energy to produce the vital phenomenon of living bodies. Al-

though we cannot say what life is we know that it exists and that its existence requires the conversion of energy and the presence of matter.

On this earth living bodies are mostly composed of carbon, nitrogen, hydrogen, and oxygen; but it is conceivable to have life with the living bodies composed of other elements. Perhaps on other planets, as Mars, living beings have a different chemical composition and are surrounded by an entirely different atmosphere from our air. However, it is probable that living matter is made up of nearly the same elements in all parts of the universe.

All forms of living beings, plants and animals and all organized matter, are composed of cells; minute bodies too small to see with the naked eye but quite plainly seen with the microscope. This living cell is our limit, we know that all living beings are made up of them, and we can study something of their structure and life, but we cannot go beyond.

These cells adapt themselves to innumerable functions and can exist separately, living as independent beings. Comparing the human body to a government, each human being of a government occupies the same position in relation to that government that the small cell occupies in relation to the human body as a whole. In a government certain human beings, as the President, Congress, and others have authority over all others; others advise, others see to the carrying out of the wishes of those in authority, and so on down to the differentiation of the lower classes into engineers, blacksmiths, etc.

Now in the human body you have the fore part of the brain, which has the cells which initiate the impulses of the will, and these cells we might say correspond to the class that govern. Then you have the after part of the brain, where memory of things seen is stored up, and the side of the brain aft, where memory of things heard is stored up. These might be called the office force or departments. Fibers pass between

all of these cells, and by coordination of impulses between them thought takes place. Now going on down the line you have cells on the top and sides of the brain which control the muscles of the various parts of the body, and these connect with and are controlled by the cells which initiate thought, reason and will, so that by coordination between the cells that retain the memory of things seen and heard, etc., things are reasoned out by the brain and impulses are sent accordingly to the centers (cells) which control the various muscles, and thus thoughts are expressed by the action of these muscles.

From the cells which control the movements of the body nerve fibers run out at the base of the brain, down the spinal cord and out through their respective nerves to the muscles they control.

Now this gives a hazy idea of what the nervous system is and how it corresponds to the chief officials and clerical force of a government. As you go down the line you have cells whose function it is to carry food to the various parts of the body: these are the blood cells. The muscles are made up of cells whose sole function is to contract and by this contraction do mechanical work.

All of these cells, no matter where located or whatever their function, are essentially alike, and essentially like many unicellular organisms, which live as independent beings, such as the ordinary amœba found in ponds and which may be described as follows: It is a single cell composed of a mass of protoplasm enclosing one or more vesicular bodies called nuclei. As previously stated, all living beings, whether plants or animals, and from highest to lowest, are composed of cells, and these cells are composed of a small mass of protoplasm enclosing a small round body called a nucleus.

It is this protoplasm, often called "the active principle of life," which gives rise to all the activities during life which we call vital phenomena.

Now although we do not know what life is, we do know a lot about living cells. They have certain peculiarities called vital phenomena, which are, (1) Power of motion; (2) Power of nutrition; (3) Power of reproduction; (4) Power of passing through the cycle of life.

Motion.—This occurs in all forms of life, both plant and animal. At first thought one is not disposed to consider plant life as endowed with motion, but the tons of weight in a large tree have been raised against gravitation; and more active, but less forcible, evidences of motion are seen in the evening primrose, etc.

The simplest form of motion in animal life is seen in the amœba, which simply changes shape by contracting in one diameter and extending in the other.

Nutrition.—Under this head we usually recognize a series of most complex chemico-physical processes; the complexity of which, however, is in large measure dependent upon the wide differentiation of the cells set apart for this work. If we take one of the simpler forms of life and study this function, we shall see it presenting only the essentials. In the amœba we see the organism living by a mere exposure of its surface to the oxygen of the medium around it. We see the flow or streaming of its protoplasmic body by which this exposure is constantly renewed. We see it receive into its clear, jelly-like body, small particles of leaves, etc. We see these slowly dissolve and disappear, and we cannot but perceive the utility of the streaming as a means by which all parts are equally supplied with nutriment. In this we have an epitome of the complex nutritive functions.

Reproduction.—The general plan of reproduction may be divided into two forms. One in which there is a division of an organism into parts, which henceforth develop independently; the other the separation of a part which develops individually, from an older organism which continues to exist.

The former is the rule among the protozoa, the latter the rule among the metazoa, to which class man belongs. In the first form there is little or no differentiation into sexes, in the latter there is a differentiation into female and male forms. The female produces the germ cell or ovum and the male the sperm cell or spermatozoon, which is necessary for the fertilization of the ovum. As this differentiation into sexes proceeds, we have more or less evidence of sexual contact, preceding the reproductive process, and when we reach the higher forms of life the complex act of coitus forms an essential preliminary in reproduction. At this point we might state that most living organisms, the higher forms of animal life at least, start their existence as separate individual beings, as a single cell, this cell being formed by the union of two single cells, one from the female and one from the male parent.

Cycle of life.—We may say that all organisms, both plant and animal, when not interrupted by premature death, pass through all its phases. The first of these phases, birth, means but a separation from the parent organism, with the power of independent life. The next of these, growth, is the power of increasing in size and substance. The next phase, decline, presents no sharp limit, but we may say that decline begins for an organism when the general nutritive activities have diminished to the extent that the waste is greater than the repair. From this time on functional activities fail and we soon see the cessation of all functions, death.

The human body, like all other organisms, is made up of cells, all essentially alike, but modified in shape, size and structure in order to adapt themselves to the functions they have to perform. These cells make up the various tissues of the body and are classed and described as follows:

Epithelial tissue.—This is in the form of a pavement covering the surface of the body, and lining body cavities. It is made up of cells of various shapes laid side by side and one on

top of the other. The outer layer is made up of flat cells laid on like tiles, and under this and supporting it are cells which are more or less round or cuboidal in shape. The skin is composed of epithelial tissue.

Skeletal tissue.—This is divided into fibrous, cartilaginous, and bone tissue.

Fibrous tissue is made up of elongated cells and is interwoven throughout most soft tissues in a way to hold them together.

Cartilaginous tissue is formed from cells which lay down around themselves a hard, tough, elastic, translucent substance. A large number of cartilage cells connected by this tough cartilage substance, which they themselves have formed, makes a piece of cartilage.

Bone tissue is formed by cells which lay down a mass of tough substance around themselves and then deposit lime salts, which they extract from the blood, in it. A large number of bone cells connected together by the bone they have formed themselves makes a piece of bone. When a bone is broken the bone cells at the fractured ends begin to multiply by simply dividing into two cells, each of which grows to the size of the original or parent cell and then divide, making four cells, and so until enough cells are formed to fill in the space between the fractured ends. They then lay down a tough substance around themselves and later deposit lime salts in it, thus uniting the fractured ends with newly formed bone.

Contractile tissue or muscle tissue.—This tissue is made up of cells of an elongated shape lying side by side. By the contraction of each individual cell you get the contraction of the muscle as a whole.

Conductile tissue or nerve tissue.—This is made up of cells of various shapes from which run long processes or fibers. Their sole function is to carry impulses or sensations from one part of the body to another.

Fluid tissue.—This is the blood and lymph. The blood is filled with cells (5,000,000 to the cubic centimeter) whose sole function is to carry oxygen to and carbon dioxide from the tissues. It also contains cells (6000 to the cubic centimeter) that look and act like the ordinary amœba found in ponds, which we spoke of further back. They go around, being only 1/2500 inch in diameter, and squeeze in between the cells which line the blood vessels, working their way through these walls and out into the surrounding tissue, where they pick up particles of waste or foreign material, destroy bacteria, etc.

CHAPTER II.

GROSS ANATOMY AND PHYSIOLOGY.

In the previous chapter we dealt with the minute bodies called cells, which go to make up each and all of the tissues of the body; we will now view these tissues as a whole.

The skeleton.—The body has a bony framework, which supports and gives shape to all of the other tissues, and owing to the fact that the bones are connected together in a way in which they can be used as levers, great range of motion is possible.

The skeleton is made up of about two hundred bones, which are of all sizes and shapes; some acting as levers, the muscles furnishing the power; others acting as supports for organs or forming cavities for the protection of organs, as in the case of the skull, which contains the brain.

The skeleton viewed as a whole is seen to consist of a central bony column, the vertebral column, which supports the head on its upper end, the chest wall and upper extremities near its upper end, and at its lower end it is attached to the pelvic girdle or hip bones, to which are attached the lower extremities.

The spine is made up of a number of bones placed one on top of the other with a flexible fibrous disk between each. There are twenty-six vertebræ, and the motion between any one of them is very slight, but when you take the combined motion between all of them the range is quite wide, allowing bending backward, forward, to either side, and twisting. The spinal column, although made up of many separate bones, is so firmly bound together that it forms a very strong central support for the attachment of the various parts of the body.

We will now take up the bones and joints in detail, describing the bones of the spine first.

The spine, or vertebral column, is made up of twenty-six irregular shaped bones called vertebræ. They each have a heavy round anterior or front portion, back of which is a circular opening surrounded by a ring of bone. The front portion is called the body, and it is this portion which forms the spinal column. The piling of these bodies one on top of the other forms a column. The circular opening behind the body forms by the placing of one vertebra over the other the spinal canal for the spinal cord. At the back of each ring is a projection called the spinous process. It is these little projections which you can see or feel by looking or feeling down the center of the back.

The cranium, or head, is made up of eight bones. In front, forming the forehead, is the frontal bone. On either side and on top are the two parietal bones, forming the top of the skull. Behind is the occipital bone, which forms the back of the head. On either side is a temporal bone forming the temple and including the ear. At the base of the skull is the sphenoid bone, on which the brain rests. Beneath the front part of the brain, and forming the roof of the nasal cavity, is the ethmoid bone.

The face is made up of fourteen bones: Two nasal, forming the bridge of the nose. Two malar, forming the cheeks. Two upper jaw bones, forming the upper jaw, and supporting the upper teeth. One lower jaw bone, supporting the lower teeth. The rest of the bones of the face are small and not so important.

The chest is made up of twenty-six bones in front, and the vertebral column behind. In front we have the breast bone and on each side twelve ribs. The breast bone is a long flat bone which forms the front of the chest; it is about two inches wide, and extends from the interval between the inner extremities of the clavicles to the apex of the angular interval between the ribs in front. The ribs are twelve in number on each side. The first seven are connected in front with the sternum through the

intervention of the costal cartilages; they are called true ribs. The remaining five are false ribs. Of these the first three have their cartilages attached to the cartilage of the rib above; the last two are free at their anterior extremities; they are termed floating ribs. All of the ribs are connected behind with the spinal column.

The upper extremity, or arm, is made up of thirty-two bones on each side. These are classed as follows: In the shoulder two, the clavicle or collar bone, and the scapular or shoulder blade. The former passes over the front of the neck on each side, being attached at one end to the upper end of the breast bone and at the other end to the head or upper end of the scapula, or shoulder blade.

The shoulder blade is a large flat, triangular bone, which covers the back part of the shoulder on each side. Its upper angle is thick and heavy and has a socket for the reception of the ball head of the humerus, or arm bone.

The humerus.—There is only one bone in the arm, the humerus. It is long and round, and has a ball-shaped head at its upper extremity which fits into the socket on the upper angle of the shoulder blade. Its lower extremity is fashioned in a way to form one side of a hinge.

In the forearm there are two bones, the radius and ulna. They are long and round in shape, and are placed parallel side by side. Their upper extremities together are fashioned to form one side of a hinge, which, with the lower extremity of the humerus, forms a hinge joint, the elbow joint. The lower extremities of these two bones together form a cup-shaped cavity for the reception of a convex surface formed by the bones of the wrist. The bones of the wrist are eight in number, are small and irregular in shape, and are loosely connected by ligaments to allow for freedom of movements.

The bones of the hand are called metacarpal bones; they are five in number: one for each finger and one for the thumb.

The bones of the fingers are called phalanges. There are three phalanges for each finger, and two for the thumb.

The bones of the lower extremity are thirty-one in number on each side. They include the pelvis, which is a girdle of bones formed behind by a large bone at the lower end of the spine called the sacrum. Extending around from this on either side and uniting in front to complete the girdle are the two os innominata, or pelvic bones. On the outer side of each of these pelvic bones is quite a large cavity or socket for the reception of the ball head at the upper end of the femur, or thigh bone.

The femur, or bone of the thigh, is the largest bone of the body; it is round in cross section, extending from the hip to the knee. It has a ball at its upper extremity to enter into the formation of the ball and socket joint of the hip; and at its lower extremity it is fashioned to form one-half of the hinge joint of the knee.

The bones of the leg are the tibia and fibula, placed side by side like those of the forearm; but here one bone, the tibia, predominates in size over the fibula; that is, it is the tibia or inner bone of the leg which supports most of the weight; and it is the upper and lower extremities of the tibia which enter almost entirely into the formation of the knee and ankle joints, respectively.

The ankle, or tarsus, is composed of the astragalus, which, with the lower end of the tibia and fibula, forms the ankle joint; the os-calcis, which is the heel bone; the scaphoid, cuboid, and three cuneiform bones, which enter into the arch of the foot; the metatarsus, like the hand, is made up of five long bones; and the toes each have their three phalanges.

Joints or articulations are connections between two or more bones, whether allowing movement between them or not.

Joints are classified as follows: 1. Synarthrosis, or immovable joints—schindylesis, or grooved joints; gomphosis in

sockets, as the teeth; suturæ, as in bones of skull. 2. Diarthrosis, or movable joints—arthrodia, or gliding joints; ginglymus, or hinge joints; enarthrosis, or ball and socket; amphiarthrosis, mixed type.

Immovable joints occur principally about the head and face. The grooved joints occur in some of the bones inside of the nose. An example of a socket joint is the connection between a tooth and the jaw bone.

The bones of the skull are connected by interlocking teeth or sutures.

In movable joints the bones forming the articulations are generally expanded at the ends for greater convenience of mutual connection, covered by cartilage, held together by strong bands or capsules of fibrous tissue called ligaments, and partially lined by a membrane, the synovial membrane, which secretes a fluid to lubricate the various parts of which the joint is formed; so that the structures which enter into the formation of a joint are bone, cartilage, fibro-cartilage, ligament, and synovial membrane.

Arthrodia or gliding joints are formed by the approximation of plane surfaces or one slightly concave and the other slightly convex, the amount of motion being limited by the surrounding ligaments to a slight gliding of the opposing surfaces. Examples of this form of joint are found in the articulations between the small bones of the wrist and ankle.

Ginglymus, or hinge joints.—In this form of joint the articular surfaces are moulded to each other in such a manner as to permit motion only in one plane. Examples of ginglymus joints are: the elbow, the knee, the ankle, and the joints of the fingers.

Enarthrosis or ball and socket joints.—In this form of joints the distal bone is capable of motion around an indefinite number of axes, which have one common center. It is formed by the reception of a globular head into a deep, cup-like cavity, the

parts being kept in apposition by a capsular ligament strengthened by accessory ligamentous bands. Examples of this form of articulation are found in the hip and shoulder.

Amphiarthrosis or mixed joints.—In this form the contiguous osseous surfaces are connected together by broad, flat disks of fibro-cartilage, as in articulation between the bodies of the vertebræ.

The muscles.—The prime function of the muscles is to produce motion. Besides the muscles under the control of the will, nearly every organ in the body is supplied with some muscular tissue in the form of involuntary muscle fiber; so we have two kinds of muscles: the voluntary, which you can feel beneath the skin, and which are under the control of the will, and the involuntary, which make up the heart's muscle and occur in the walls of the stomach and intestines, and in many other organs, and are not under the control of the will.

Voluntary muscles.—We will consider the voluntary muscles first; they form the firm flesh, which gives the shape and contour to the body. It will be seen that they everywhere cover the bones, except around the large joints, and where the edges of some of the flat bones show beneath the skin.

The function of all muscular tissue is to contract; voluntary muscles contract when called upon to do so by the will. When a muscle contracts it draws upon the parts to which it is attached, bringing them closer together.

As before stated, one of the functions of bones is to act as levers and produce a wider range of motion than could be accomplished by the simple contraction of a muscle. A jelly fish contracts and expands, but it has no range of motion.

By the pulling of muscles on bones, we get, through lever action, a wide range of movement. Of course the muscle almost always acts on the short arm of the lever, thereby losing in power, but since they develop to the size and strength which are necessary to do any work required of them, within certain

limits, the combination of bone and muscle as it is displayed in the human body forms a beautiful system of levers, with the power, in the form of muscular power, applied in a way which gives wide range of motion, and greater power when needed.

An example of limited range and greater power is shown in the lower jaw, where the fulcrum is at one end and the weight at the other with the power about midway between the two. The range of motion of the jaw is not very wide, but for the size of the jaw muscle it has a great deal of power. This is an example of the lever of the third class.

A lever of the first class is displayed by the head resting on the top of the spine. The top of the spine is the fulcrum, and the head is the weight; the power is furnished by the muscles of the back of the neck, which raise the head and pull it backward.

A lever of the second class is shown at the ankle joint; in rising on the toes the fulcrum is at the toes, the weight in the middle at the ankle joint, and the power at the heel, and furnished by the muscles of the calf of the leg.

Muscles are attached by tendons, at both ends as a rule, and the central red, meaty portion is the part which contracts. In growing shorter it swells up; that is, increases in transverse diameter and diminishes in length. This is very prettily shown when the muscle of the front of the arm contracts. This muscle, the biceps, is attached by a tendon at one end to the shoulder bone, and at the other end to the bones of the forearm, a little below the elbow joint. When this muscle contracts the front of the arm swells up and, with the biceps acting to furnish the power, we have a lever of the third class; the forearm being the lever. The fulcrum is at the elbow joint, the power in the middle, and the weight is in the hand.

The upright posture is maintained by the action of strong ligamentous bands, binding the bones of the spine to each other and to the lower and upper extremities; the muscles

assist in holding the body erect, and are in a constant state of contraction when the person is standing. The body is balanced in such a way that the center of gravity lies over the center of the base on which it rests, which is made by the two feet. Any change in line by one part of the body necessitates another part being placed out of line to keep the center of gravity from falling outside of the base formed by the feet.

In walking the body is simply kept with the center of gravity in front of the toes, and at the same time the feet are brought successively forward to keep the base under the center of gravity. All the muscular action brought into play is that necessary to bend the knee slightly and to swing the limbs alternately forward. There is some action of the calf muscles pushing the body forward at each step.

The involuntary muscles act independent of the will. They occur in the heart, which is entirely made up of muscle; in the walls of the intestines and stomach, where they keep the contents moving onward toward the rectum; and they occur in the walls of the blood vessels, so that when a part has too much blood they can by contracting shut off some of its supply. In case of hemorrhage the walls of the arteries, which are bleeding, contract and thereby help to stop same.

The involuntary muscle in the heart's walls keeps on rhythmically contracting throughout life, and any interruption in its work means death.

The muscle fibers of the intestines are constantly contracting, and this contraction occurs in waves called peristaltic waves. The fibers behind a mass of food contract, and as it moves onward succeeding fibers contract; always just behind it so that it is kept moving forward toward the rectum. Lack of this peristaltic motion causes constipation.

Circulation and the circulatory system.—The organs by which this function of circulation is accomplished are the heart, which pumps the blood about the body, and the blood vessels, which carry this stream of blood.

The heart is a hollow muscular organ of a conical form placed between the lungs, just behind the breast bone. It lies a little more on the left side with its apex directed downward and to the left. The heart in the adult measures five inches in length, three inches and a half in breadth and two inches and a half in thickness. It is about the size of a closed fist. It weighs from eight to twelve ounces.

The heart's cavity is divided by a partition into two halves, and each of these halves is divided by a horizontal partition.

The two halves of the heart are right and left, and the cavities at the base are known as the right and left auricles, and the cavities at the apex are known as the right and left ventricles.

There is no communication between the two halves of the heart, but through the partition which divides each of the halves is an opening which is a valve seat, as there is a valve in the form of a strong membrane, which is attached to one side of this opening and flaps free into the ventricle. Pressure from the ventricular side of this valve will cause it to close over the opening.

The action of the heart is brought about by the contraction of the involuntary muscular fibers in its walls. They contract rhythmically about seventy times a minute. Each time they contract they diminish the size of the cavity of the heart, and just like you can squeeze water out of a rubber ball, so the blood is forced out of the heart with each contraction.

Each time the heart contracts it forces blood into the arteries which run to the various parts of the body, and during each interval between the contractions it fills with blood brought to it by the veins.

There are really two circulations carried on by the heart; the right side pumping blood to the lungs for aeration, and the left side pumping blood to all parts of the body by way of the arteries.

The course of the blood is from the right side of the heart to the lungs, where it gets oxygen and gives off carbon dioxide; from the lungs it returns to the left side of the heart, from whence it is pumped all over the body, giving off its oxygen to the tissues and taking up carbon dioxide from the tissues; it also furnishes nourishment and warmth.

The blood is collected from all over the body by veins, which unite to form one big vein that empties into the right side of the heart, to be again pumped to the lungs for purification and returned to the left side of the heart, to be pumped through the aorta and its branches all over the body, as before.

The heart does an enormous amount of work each twenty-four hours, by its constant contraction; enough to raise a ton of coal two hundred feet. The heart has the greatest strain of any organ of the body, and should always be considered when judging whether a person is equal to any particularly hard task.

The heart is really a double pump, the right and left sides being entirely separated from each other by a partition. The right heart pumps blood to the lungs, from whence it returns to the left side of the heart. The left side of the heart pumps blood to the whole body, from whence it is returned to the right heart to begin over again.

Arteries.—The arteries are hollow tubes whose walls are made up of three coats, an inner coat of flat cells called the interna, a middle coat of circularly arranged muscle fibers called the media, and an outer layer of fibrous tissue called the adventitia.

In describing the arteries we begin with the heart, which is located in the chest a little to the left of the middle line, just behind the breast bone. Its base, from which point the aorta or main artery comes off, is about two inches below the top of the breast bone and directly behind it. From this point the aorta curves backward and then downward along the front of

the vertebral column through the chest and abdomen to a point above the pelvic cavity, where it divides into two arteries, one to each lower extremity. These two terminal branches of the aorta pass down into the thigh under the name of the femoral artery. The femoral artery emerges from the center of the groin and passes down the inner side of the thigh, gradually becoming deeper and winding around the thigh bone to a point directly behind the knee joint; from this point it passes downward for a couple of inches into the leg, where it divides into two branches, one of which passes between the two bones of the leg to the front of the leg, then down the leg to the front of the foot. The other branch passes down the back of the leg to the inner side of the ankle and from thence to the under side of the foot.

The aorta in its first few inches after it leaves the heart gives off branches to the upper extremities and to the neck and head. The branches to the head are one on each side, called the common carotids, which pass up into the neck and then divide into two branches, the internal and external carotids. The internal carotids pass one on each side through the base of the skull to supply the brain with blood, and the external carotids give off branches to supply the neck, face, and head.

The branches from the aorta to the upper extremities, one on each side, are called the subclavian. Starting from the first part of the aorta, the subclavian arteries run outward on each side; at the base of the neck they pass under the shoulder, where they are called axillary arteries. The axillary artery passes to the inner side of the arm, where it becomes the brachial artery, which passes down the inner side of the arm to a point in front of the elbow joint, and just below this it divides into two branches, the radial, which passes down the outer side of the front of the forearm, and the ulnar, which passes down the inner side of the front of the forearm. The ulnar branch gives off a branch to the back of the forearm,

which passes between the two bones of the forearm and is called the posterior interosseous. The terminal branches of these last three named arteries supply the hands.

After giving off branches to the head and upper extremities the aorta passes backward and then downward on the front of the spine; while passing through the chest it gives off branches to the chest wall and lungs. It then passes through the abdomen as before stated, and gives off branches to the stomach, intestines, liver, kidneys, spleen, and all other organs in this vicinity, and to the abdominal wall.

The veins.—The veins are the vessels which return the blood to the heart. They number a great many more than the arteries, and run superficially beneath the skin, whereas the arteries run deep for protection from injury.

Between the arteries and veins we have a system of minute vessels called capillaries, infinite in number and penetrating every part of the tissues.

The blood is the great common carrier of the body. It carries oxygen to the tissues and carbon dioxide from the tissues, food to the tissues and waste products away from the tissues, and last but not least, it keeps all parts of the body at the same temperature by carrying heat as a hot-water heating system would.

Respiration.—The lungs are the essential organs of respiration; they are two in number, one on each side in the chest, separated from each other by the heart.

Each lung is conical in shape, with its base resting on the diaphragm and its apex extending about one inch into the neck.

Respiration, meaning literally "to breathe again," is here used to describe the gaseous interchanges that take place in the blood. These interchanges take place at two points in the blood's circuit; one in the capillaries in the lungs, called pulmonary respiration, and the other in the capillaries in the tissues at large, called interstitial respiration. In pulmonary

respiration the blood in the capillaries of the lung is, by the mechanical act of respiration, exposed to the influence of the oxygen of the air; and it takes up oxygen, and gives off carbon dioxide, which it contains in large excess.

In interstitial respiration the blood flowing through the general capillary system of the body is brought into intimate relation with the tissues of every part, and it gives off to the tissues for their sustenance oxygen, which we saw it take from the air, and now takes in exchange carbon dioxide, which, as we saw, it eliminates in the lungs.

Capacity of the human thorax.—The sum total of the air capable of being taken into the thoracic cavity may be divided as follows:

	Cubic inche
Tidal Air—That going in and out during ordinary respiration	20
Complemental Air—That which can be taken in after an ordinary inspiration	100
Reserve Air—That which can be expelled after an ordinary expiration	100
Residual Air—That remaining in the lungs after the most complete expiration	100
	320

It will be seen that the efficiency of respiration depends upon the capacity of the lungs and on the power of the heart to circulate blood through the capillaries of the lungs.

As the muscles are the greatest consumers of oxygen and producers of carbon dioxide, muscular endurance depends to a large extent upon the capacity of these two organs.

The nervous system.—The nervous system is comprised of the brain, spinal cord, and nerves.

The brain is a solid organ made up of nerve cells on the outer surface and nerve fibers converging from same in the interior. The portion on the surface which has the brain cells is gray in color and is commonly called gray matter of the brain. Inside

of this covering of gray matter is a mass of nerve fibers which run from one gray matter cell to another and from gray matter cells down through the base of the brain and into the spinal cord.

The brain is divided into two parts, the cerebrum and the cerebellum. The cerebrum is much the larger, and consists of the top and fore part of the brain. The cerebellum is the lower back part of the brain.

The spinal cord is made up of a continuation of the fibers from the brain down through the spinal canal.

It starts at the base of the skull and extends to the sacrum, being encased by the canal formed from the superimposed rings of bone on the back part of the vertebræ, the spinal canal.

The nerves are divided into the cranial nerves, which proceed from the base of the brain, and the spinal nerves, which come off from the spinal cord and emerge from the vertebral canal between each of the vertebræ.

The cranial nerves include the nerves of special sense and those which supply all parts of the face and neck with motion and sensation.

The spinal nerves pass out at various levels from the spinal cord and are distributed to all parts of the body.

The function of the nervous system is to keep the brain informed of surrounding conditions, to coordinate impressions received, producing thought and reason, and to express the workings of the mind by impulses sent to the muscles; also to coordinate the workings of all the organs of the body.

Digestion.—Digestion is a chemical process. You all know that if you put a piece of iron in an acid, as sulphuric acid, it will be dissolved and will make a solution of iron sulphate; and this iron sulphate by a certain process can be converted back into iron. So in digestion. Meat is dissolved by the ferments of the stomach and intestines and forms peptones in solution, which are absorbed into the blood and reconverted into meat, as muscle.

There are three principal classes of food—Proteids, Fats, and Carbohydrates; and these different classes of food have to have different kinds of digesting fluids to dissolve them.

Starting at the mouth, the food goes through the œsophagus into the stomach, from stomach into intestines, and after passing through the thirty-two feet of intestines what is not digested and absorbed is passed off.

While in its passage the food is acted on by the following ferments:

1. In the mouth by: Ptyalin, which converts starch into sugar.
2. In the stomach by: Pepsin and hydrochloric acid, which convert proteids into peptones.
3. In the intestines by: Trypsin, which converts proteids into peptones. Amylopsin, which converts starch into sugar. Steapsin, which emulsifies fats.

The peptones, sugars, and emulsified fats thus formed by the ferments of the mouth, stomach, and intestines, are absorbed and carried by the blood stream to all parts of the body to nourish the tissues.

Excretion.—It was seen that the lungs excrete carbon dioxide, the result of the combining of the carbon compounds taken into the body by the digestive apparatus with the oxygen taken into the body by the lungs.

The waste or end products of the breaking down of the tissues due to daily wear and tear are urea and uric acid, and these are excreted by the kidneys, a pair of organs situated in the back part of the abdomen in the loins, one on each side of the back bone and each about the size of the closed fist.

The skin excretes a certain amount of waste products in the sweat.

CHAPTER III.

BACTERIOLOGY.

Bacteria.—Bacteria, or germs as they are commonly called, are minute single cell organisms belonging to the vegetable kingdom. They reproduce by simply dividing into two parts, which develop independently, and when mature, themselves divide, thus making four; and so on *ad infinitum*. Though so small that a million could be placed on the point of a pin and would make a mass which would be scarcely visible to the unaided eye, yet one germ placed in favorable surroundings could by multiplying fill the Atlantic Ocean in a short time. Of course, everywhere in nature there are opposing forces, and these minute plants have their enemies in the form of other antagonistic bacteria; and, like all living organisms, they have to get rid of their own waste products. That is, when the media in which they live becomes impregnated beyond a certain extent with the poisons which they themselves form they can no longer live. This is a law which holds good throughout all nature: no species can live surrounded by its own waste products; and confirms the axiom that cleanliness is next to godliness.

In certain parts of Europe where wine is aged in large vats great care has to be exercised in order to keep a certain species of bacteria from entering. This bacteria has been known to turn a million gallons of wine into vinegar in twenty-four hours.

It is hard to conceive how such a little thing as one bacteria can bring about so great a change, and yet this is nothing compared to the part these minute plants have played elsewhere in the history of the world. History will tell where campaigns

have been lost through disease caused by them and the whole tide of the human race turned.

Eighty per cent of the wounded who do not return to the front would do so if it were not for wound infection.

Bacteria, like all other forms of life, require food, water, and certain surroundings in the way of temperature and quantity of air and light.

They are all either parasitic or saprophytic; that is, for food, they require either living or dead organic matter.

They are obligate parasites if they can live only on living matter, facultative parasites if they live on living matter, but can exist on dead matter; obligate saprophytes if they can live only on dead matter, and facultative saprophytes if they can live on dead matter, but can exist on living matter.

They all require moisture; the total absence of water will cause their death.

They all have a certain temperature at which they thrive, called the optimum temperature. There is also a maximum and a minimum temperature at either of which they cease to grow. Some are destroyed by freezing, and all are destroyed by heat over a certain temperature. Boiling will destroy any bacteria; some in a few minutes and others in a longer time, all within an hour.

Some bacteria require air for their growth; these are called obligate aerobic. Others can grow with or without the presence of air; these are called facultative aerobic; while others cannot grow in the presence of air, and are called anaerobic.

Light seems to be detrimental to the growth of all forms of bacteria, especially sunlight.

Bacteria include a large group of unicellular organisms belonging to the vegetable kingdom, and are classified according to their shape. There is the rod-shaped class, being about three times as long as broad, which are called bacilli; a spiral form, being a long rod coiled like a spiral, which are called

spirochætes; and a round form, being spherical in shape and called cocci. Examples are:

Bacilli.—The tetanus bacillus, which is a facultative saprophyte, anaerobic, and whose optimum temperature is about one hundred Fahrenheit. This germ is the cause of lockjaw, and lives in the ground (rich garden soil or manure). A wound by an instrument which has been in contact with the ground may introduce it. The wound, if deep, will satisfy the requirements for its growth, as it is anaerobic and cannot grow on the surface in the presence of air.

A deep wound by a rusty nail or rake should be opened up and disinfected immediately.

Spirochætes.—Spirochæta pallada, obligate parasite, facultative aerobic, optimum temperature that of human body (98.6). Found in sores and blood of persons infected with syphilis, and is the germ causing that disease. Transmitted from person to person by contact.

Cocci.—Streptococcus pyogenes, obligate parasite, facultative aerobic, optimum temperature that of human body. Found in abscesses and blood of persons with blood poison. Transmitted by wound and contact.

Germs may enter the system in many ways, by wounds, through mucous membranes, as that of mouth, nose, throat, bronchial tubes, lungs, stomach and intestines, and through the skin when injected by a blood-sucking insect. When a person is sick with a certain disease the germs of that disease are most abundantly present in the parts most affected; as in diphtheria the throat is covered with diphtheria bacilli, which are cast off into the surrounding air with the particles of spray formed while coughing. This spray does not carry very far, but settles on nearby objects, which become covered with the germs; and consequently contact with them may produce infection. If standing near a person with diphtheria, this fine spray formed by coughing may be taken into the throat and

cause infection. The tubercle bacilli, which cause tuberculosis, are spread in the same way. These germs are mostly obligate parasites, require moisture to live, and are destroyed by sunlight, but they will remain alive outside the body in small particles of sputum for many hours, and, if stirred up into the air in the form of dust, particles will be taken into the respiratory passage, where they lodge and start up an infection.

As a great many germs are facultative parasites—that is, they grow best on living matter, but can live as saprophytes on dead matter—it is easy to see that filth, most of which is dead organic matter, is conducive to the life of disease.

Cleanliness, sunlight, and fresh air act to destroy disease: the first by removing the food upon which it lives during its passage from one person to another; the second by its destructive effect on bacteria; and the third by carrying dust particles outside where they can be acted on by the direct rays of the sun, and also by its drying effect, moisture being necessary to germ life.

As an adjunct to cleanliness, sunlight, and fresh air in the process of disease elimination, various disinfectants are used; and their effectiveness depends upon the thoroughness with which they are applied.

Some of the most effective germicides are: A solution of bichloride of mercury in water, one to two thousand; chlorinated lime; formaldehyde, and alcohol.

Animal parasites.—The only parasites, with few exceptions, belonging to the vegetable kingdom which cause disease are the bacteria; and these are all unicellular organisms; but the parasites belonging to the animal kingdom which produce disease include both unicellular and multicellular forms. They range in size from the unicellular organisms which cause malaria, amebic dysentery, and sleeping sickness, to the large worms which occur in the intestinal canal, such as the tapeworm, round worm, and hookworm.

They do not enter into the infections of wounds, and they do not spread with such rapidity as bacteria infection; but they include one of the most widespread infections—malaria—and a great many tropical infections.

They are nearly all obligate parasites, and they almost all have a double life cycle requiring two hosts to complete their existence: as, for instance, the malarial parasite, which has a certain phase of its existence in the blood of man and another phase of its existence in the body of the mosquito.

Parasitism is one of the most common phenomena in the world. No animal is free from parasites. Man has about fifty different species which are frequently present, and a couple of hundred which are more or less rare. They occur in the blood, living on the blood corpuscles, in the intestines, where they suck the blood through its wall, and in almost any organ of the body. The majority produce no ill effects, others produce slight symptoms, while only a few give rise to any serious trouble. The malarial parasite and the ameba which causes amebic dysentery in the tropics are the ones with which we are the most concerned and which will be described under the head of preventable diseases. Animal parasites are mostly transmitted through food, water, and by insects. The cooking of food, boiling of water, use of mosquito nets, and scrupulous cleanliness of person and sleeping quarters, will eliminate these diseases.

CHAPTER IV.

PREVENTABLE DISEASES.

Under this head are included diseases which can and should to a large extent be prevented by hygienic measures. It includes diseases which are transmitted by food, water, insects, and contact.

With the aid of the microscope and various laboratory methods the cause of most infectious diseases have been found to be due to bacteria or animal parasites, and their methods of transmission have been worked out. With this knowledge means have been devised whereby the transfer of contagion from one person to another can be prevented. Of course the stopping of the spread of any particular disease can be accomplished in part or completely, depending on the facilities at hand and the care in carrying out the process.

It is always imperative that every effort be made to avoid all forms of contagion and to stamp out same before it gains a foothold.

Germs, like all living organisms, require food and favorable surroundings in order to live and multiply. A great many are obligate parasites and cannot live long outside their infected host; they have to continue their existence by passing directly from living host to living host. Other germs are facultative parasites, spending part of their existence in the infected host and living the rest of the time in dead organic matter (filth) as saprophytes. Certain animal parasites undergo a part of their life cycle in an animal as host and part of their life cycle in some insect as host. Still others pass from animal to animal by one animal eating the flesh of the other.

In order to intelligently consider the methods of prevention of infectious diseases, it will be well to first classify them according to their methods of transmission and then consider each one separately, giving its most characteristic symptoms so that it can be recognized; diagnosis being the first step in carrying out prevention of the spread of any particular disease, as you must know what disease you are undertaking to stamp out. A brief outline of the treatment for each of the diseases considered will also not be remiss.

The following is a classification of infectious diseases according to their methods of transmission, and includes most of those which you as naval officers will chance to meet:

Transmitted by food and water which have been infected by the discharges of persons sick with the disease. Also carried by dirt particles clinging to the feet of insects.	1. Dysentery. Amebic—occurring in tropics. Bacillary—occurs in all parts of the world. 2. Cholera. Occurs in all parts of the world. 3. Typhoid fever. Occurs in all parts of the world.
By contact with person or infected articles of clothing or furniture.	1. Diphtheria. 2. Scarlet fever. 3. Measles. 4. Mumps. 5. Chicken-pox. 6. Smallpox. 7. Tuberculosis. 8. Cerebro spinal meningitis. 9. Trachoma, or granular lids.
Transmitted by insects which draw blood from infected animals and inject it into non-infected animals.	1. Malaria, by mosquito. 2. Yellow fever, by mosquito. 3. Dengue, by mosquito. 4. Elephantiasis, by mosquito. 5. Bubonic plague, by rat flea. 6. Typhus, by the body louse. 7. Kala azar, by the bedbug. 8. Sleeping sickness, by the tsetse fly and Lamus bug. 9. Leprosy, by bedbugs. 10. Rocky Mountain spotted fever, by the tick.

Besides the diseases under this classification there are a few others, due to different causes, with which a naval officer may

come in contact. They are diseases due to insufficient or improper food, and diseases transmitted by uncooked meat:

Diseases due to insufficient or improper food....	1. Scurvy. 2. Beri-beri. 3. Pellagra.
Diseases transmitted by uncooked meat	1. Animal parasites { Trichinosis. Tape worms.

For protection against those diseases transmitted by food and water, prevent the food and water from becoming infected, and, if this is not possible, destroy the infection.

The former requires a great deal of care, and the latter must be done systematically and thoroughly in order to eliminate any danger.

There are so many avenues by which infection may enter that great care must be taken in order to be sure that food and water are not contaminated, and when contaminated food is sterilized that it is not reinfected.

All food should be carefully cooked, which will kill any contagion; and then it should be protected from reinfection right up to the time it is eaten.

This requires scrupulous cleanliness about the kitchen and mess room, both of personnel and material. Food, well cooked and sterile, may be infected between the time it leaves the stove and when it is eaten. This may be due to dirty pots and pans, or serving dishes, or to dirty hands.

All kinds of insects, especially flies, are a great source of danger at this point. In improperly policed camps, flies with lime on their feet, plainly evident, have been seen to alight on food at the mess table. Of course there is no question as to where the fly had previously been, as the toilets were the only places where the lime had been used. The solution of this problem is scrupulous cleanliness; destruction of all scraps and remains of food in which flies will breed; placing kitchens and

mess as far as consistent from heads, stables, and dump piles; and screening them if possible.

Water is something that we cannot do without for any length of time, and it is a great source of danger to men on the march. Of course we use distilled water on board ship, and this is always safe provided the tanks in which it is stored are guarded from contamination.

On shore, in strange surroundings, no water should be used for drinking, cleaning teeth, or washing cooking utensils and mess gear unless it is above suspicion. To be above suspicion in the absence of facilities for a chemical and bacteriological examination, it must be far from human habitation, be clear and sparkling, and have a pleasant taste. Any water can be sterilized by boiling for twenty or thirty minutes, and when cool it will be safe to drink. All suspicious water should be boiled and then allowed to cool; and be sure that the cans in which it is placed to cool are clean. It is well to pour it into them while boiling hot, or allow water to cool in the container in which it was boiled. If a body of men are moving too fast to have time to boil water for drinking purposes, some chemical form of disinfectant can be used; but it is not as safe or wholesome as boiling. The habit of making tea or coffee in the individual cups carried by each man is a good practice, as it requires boiling and hence insures a safe and refreshing drink.

The three principal diseases transmitted by taking infected matter into the alimentary canal are as given in the foregoing classification: dysentery, cholera, and typhoid fever.

Dysentery.—There are two forms of dysentery, one due to the Shiga bacillus and the other due to entamœba hystolitica. The former occurs most often in temperate climates, and the latter in the tropics. They are both characterized by an intense inflammation of the lower bowel, with fever, intense pain or griping in the lower part of the abdomen, and frequent bloody evacuations of the bowels.

Treatment: For treatment give paregoric or tincture of opium for pain, and hot saline enema to cleanse lower bowel.

Cholera, due to the cholera bacillus, is a widespread disease, having occurred in epidemic form in almost all parts of Europe and Asia. It has played no small part in history, having decimated armies and civil populations with no respect to name, rank, or station.

It is characterized by fever, intense pain or cramps over entire abdomen, cramps in the legs, and frequent profuse watery discharges from the bowels, which have the appearance of thin rice soup.

Treatment: The intense inflammation of the bowels causes such a flow of watery mucus from the intestine that the system soon becomes depleted of its water. The rational treatment is injections of hot normal salt solution under the skin or into a vein. Give stimulants, whisky diluted with plenty of warm water. Keep patient quiet.

Typhoid fever, due to the typhoid bacillus, occurs in all parts of the world, but is most prevalent in the temperate zone. It is an inflammation of the middle portion of the bowels, and is characterized by fever, tenderness of the abdomen, and usually a slight diarrhea. Its diagnosis is not always easy. There are no marked symptoms, just a continuous fever, which lasts three or four weeks; and during this period the patient wastes away. The teeth, if not cleaned frequently, are covered with a brown substance, and the patient has a muttering delirium.

Preventative treatment: Typhoid vaccination and hygienic measures.

Curative treatment: Keep in bed, keep clean, sponge with ice water when fever is high, give liquid diet and plenty of water to drink. Keep a close watch when delirious.

It will be noted that all of these diseases which are contracted by matter taken into the alimentary canal are due to germs which live in and attack the bowels, and they are all character-

ized by symptoms referable to the abdomen. In all three the discharges are highly contagious. If a man gives the appearance of having any one of these diseases he should be isolated, and all of his discharges should be destroyed by heat or disinfected by chlorinated lime, carbolic acid, or some other chemical. The sheets used on his bed and any other clothes coming in contact with him should be soaked in carbolic acid and washed on the spot, not sent to the laundry.

The attendant who nurses him should wash and disinfect his hands each time he brings them in contact with him; and the attendant should sterilize his hands before he eats his meals. All of this may seem like carrying things to the extreme or being overcautious, but it can be and is carried out, and it produces results which are well worth while. Ten men disabled by disease means more than ten men away from the firing line, for humanity demands that they be taken care of; and a helpless man requires a great deal of attention.

For protection against those diseases transmitted by contact.—Prevent the contact.

In military life men are more under control than in civil life, so that they can be kept in camp or on board ship when the surrounding inhabitants are suffering with the presence of any of those diseases. Care should be taken to find out what diseases are present upon entering a port or upon marching into a new locality while on shore. Should it be absolutely necessary to have communication with the surrounding inhabitants when it is known that contagious diseases of this sort are present, as small a per cent as possible of the command should be detailed to carry on this communication; and those men should be watched for the appearance of the slightest symptoms of the disease in question; in fact, any symptoms should excite suspicion. Any one who feels bad, especially if he has any fever, should be immediately isolated; that is, placed in a tent, if ashore, or compartment, if on board ship.

This tent or compartment, as the case may be, should be as far removed as possible from the rest of the command. Should the man you have suspected and isolated later develop the disease in question, you will have to isolate also all those who have waited on him. You would simply have to establish a small separate camp, if on shore, and carry on communications with same by a special squad detailed for the purpose. In rigid quarantine it is customary to establish a half-way station where food and water and other necessary paraphernalia are brought by those from the outside; later those on the inside (at the isolation camp) come and get what is left for them. This eliminates direct contact; and to eliminate contact with infected articles, food and water are brought from the outside in one set of containers and transferred at the half-way station to containers which go back and forward from the half-way station to the isolation camp.

Often when contagious diseases break out on board a ship an isolation camp is established on the beach, and a boat is anchored half-way out to the ship to act as the half-way station. When cases are isolated aboard ship a compartment is used, and food, water, etc., are passed through the door to that compartment, no one entering or leaving the same.

When contagion has entered, and an isolation compartment or camp has been established, a lookout is kept for the first appearance of sickness among the command; and any sick are temporarily isolated in a suspect camp or compartment. If they do not develop the disease in question they are released, but if they do they are transferred to the isolation camp. Those having come in contact with the infection are also treated as suspects for the length of time required for incubation of the disease.

Diphtheria is a contagious disease due to the diphtheria bacillus, and is characterized by an intense inflammation of the throat with the formation of a dirty grayish-looking mem-

brane in same. This membrane can be easily seen on the sides and back part of the throat. The diphtheria bacilli are present in this membrane in enormous numbers, and the coughing or strangling of the patient throws them with the spray and pieces of membrane several feet from the body. Fever is present, with great prostration.

Treatment: Isolation, antitoxin, and stimulants as demanded.

Smallpox is an acute infectious disease transmitted by contact with person and surroundings. It comes on with intense headache, backache, vomiting, and fever. After about three days red spots appear on the forehead and wrists; those on the forehead feel like shot under the skin. With the appearance of the eruption the fever and headache and backache subside and the patient becomes more comfortable. These red spots develop into vesicles filled with a clear fluid like a blister, and by the ninth day they have turned into pustules filled with pus. At this stage the fever and headache return and the face and other parts affected begin to swell, the pustules becoming larger and running together and large scabs are formed.

Later, if the patient recovers, these scabs fall off, leaving bad scars. There are very mild forms of smallpox with slight symptoms and little if any scarring, and there are very severe forms, in which the whole body is one mass of scabs and the scarring is very unsightly.

Treatment: Vaccination repeated every five years will protect. It at least positively insures a mild attack with little or no disfigurement. Quarantine and isolation should be immediately carried out at all hazards.

Dressing the scabs with moist dressings and later applying ointments will give comfort and lessen the scarring.

Scarlet fever is a contagious disease which is readily contracted by contact with person or clothing of a case. It is

characterized by a profuse red rash over body, sore throat, and high fever.

Treatment: Isolation and keeping in bed.

Measles.—Patient has a red eruption over body, and fever, as in scarlet fever; there is seldom a sore throat, though the eyes and nose run as if he had a cold in his head.

Tuberculosis is an infectious disease, which, when it attacks the lungs, is characterized by cough, slight fever, and night sweats. Any prolonged slight cough with loss of weight, fever, and night sweats should be looked on with suspicion, and the case isolated to protect the rest of the command, especially aboard ship, where contact is so close.

Treatment: Send to hospital or home.

Cerebro spinal meningitis is a very fatal disease due to the diplococcus meningitidis, which occurs in the secretions from the nose during and after the disease. It is characterized by high fever, delirium, and throwing of the head backward.

Treatment: All cases should be isolated and kept isolated for some time after they recover, as the secretions from the nose remain infectious. When this disease breaks out aboard ship it is often advisable to put the whole crew ashore in tents.

It will be noted that diseases transmitted by contact are those which attack the nose, throat and surface of the body. The infection is present on the skin or in the discharges from the nose and throat. The germs are spread around in coughing or blowing the nose, or they are rubbed off the skin. Direct contact with the patient or with things which have been in contact with him, as clothes, bed clothes, or dishes, will transmit the disease. Therefore isolation of patient and disinfection of his clothes, bed clothes, and eating utensils will prevent the spread of any particular disease of this class.

Clothes and bed clothes can be disinfected by putting in a box and sprinkling with formaldehyde solution. Dishes, knives and forks, drinking cups, etc., should be boiled each time after using.

In order to transmit those diseases carried from person to person by insects, it is necessary to have two things present: first, the disease, and second, the insect which transmits the disease. Malaria is transmitted by a certain species of mosquito; yet you can have this species present in abundance and be bitten by it, and still not contract malaria. Again, you may have malaria present, and without this specific variety of mosquito it could not be transmitted to a well person.

In the case of yellow fever Drs. Reed and Carrol in Cuba lived and slept in the same room with yellow fever patients, which room was mosquito-proof by being well screened. They even handled the patients and the bed clothes of the patients, shaking them out and coming in contact with them in every possible way, yet they did not contract yellow fever. Next they took the specific variety of mosquito which was supposed to transmit yellow fever and bred them in captivity so that they could not possibly bite a yellow fever patient. These mosquitoes they allowed to bite themselves and they did not contract yellow fever. Lastly, they allowed these mosquitoes to bite a known yellow fever case and afterwards to bite themselves, with the result they both contracted yellow fever.

There can be no more proof wanted to convince any one that yellow fever is transmitted by the bite of the mosquito.

Fully as strong evidence as the foregoing has been brought out to associate other diseases with specific varieties of insects as their means of transmission; and any lack of regard for the consequences of ignoring the presence of these insects when the disease they transmit is in the vicinity is criminal negligence.

Many of these diseases transmitted by insects can also be transmitted by injecting the blood of an infected person into a well person. However, such a method of transmission is only of scientific interest, as it could never occur under ordinary conditions.

As the most widespread of the insect-borne diseases are transmitted by the mosquito, this insect will be discussed at this point.

The geographical range of the mosquito extends from the frigid zones to the equator. Given stagnant or slow-flowing water and a summer temperature, they multiply with great rapidity.

The adult insect feeds on vegetable juices, the males exclusively so, but the females suck the blood of man or other warm-blooded animals when opportunity offers. The male mosquito, not being a blood sucker, takes no part in the diffusion of diseases; it is the female only that is a germ carrier. The female lays her eggs from time to time singly or in groups, according to species, on the surface of still water, on which they float. These eggs hatch in a few days and become larvæ or wigglers, plainly seen swimming around. These wigglers, after swimming around for a few days living on the organic matter present in the water, become quiet and cease to feed; this is the nymph or pupa stage. In from one to two days the pupa-case bursts, and the insect, emerging, stands on the empty case until its wings have dried, when it flies away.

Malaria (synonyms: Remitting Fever, Intermittent Fever, Ague, Marsh Fever, Paludism, Jungle Fever) is a disease which occurs in any part of the temperate or tropical zones; the milder forms being met with in the former and the malignant forms in the latter zone.

It is due to three varieties of animal parasite: the plasmodium vivax, which causes a benign form characterized by fever every third day; the plasmodium malariæ, which causes a benign form characterized by fever every fourth day; and the plasmodium falciparum, which causes the malignant form of malaria prevalent in the tropics.

Practically we have two types of malaria: the benign and the malignant forms.

The benign form is characterized by spells of chills, fever, and sweats, with an interval of freedom from symptoms. This type of the disease is called benign because it generally leads to no ill effects, although repeated attacks may cause great anemia and emaciation, and even death.

The malignant form is characterized by continuous fever, marked loss of weight, and anemia. It resembles typhoid fever.

Treatment: To prevent, give small doses of quinine every day to each man, and have all the command sleep under mosquito nets; use methods to exterminate mosquitoes. To treat a case of malaria, give large doses of quinine (40 gr.) and nurse carefully.

Yellow fever is an infectious disease which is transmitted by the mosquito. It is characterized by sudden, rapidly rising fever, black vomit, and an intensely yellow skin, which latter develops about the fourth day. The first day or two the face is swollen and red, and the eyes are bloodshot.

Treatment: Careful nursing, which consists in keeping patient in bed, keeping him clean, and supplying his wants. Of course a case of yellow fever should be isolated in a screened compartment to keep him from infecting mosquitoes and thereby spreading the disease.

Dengue, or breakbone fever, is a disease of short duration and no ill effects. It is characterized by high fever and intense pain in the joints. It is prevalent in the tropics and is transmitted by the mosquito.

Elephantiasis is a tropical disease transmitted by the mosquito, and characterized by great enlargement of the lower extremities and scrotum.

Bubonic plague, which is transmitted by the flea of the rat, is due to the bacillus of plague and is characterized by high fever and abscesses over the body. It is a very fatal disease, and where rats are present in great numbers with their accom-

TABLE OF THE INSECT CARRIERS OF EPIDEMIC DISEASES.

(COMPILED BY DR. J. J. V. MANNING.)

PASSIVE CARRIERS.

Common name.	Scientific name.	Disease (proven).	Disease (suspected).	Victim.
1. House fly, typhoid fly, septic fly.	Musca domestica . . .	Typhoid, summer diarrhoea, Asiatic cholera, tuberculosis, bacillus of green pus, yaws (staggers).	Gangrene, hookworm, bubonic plague, Egyptian ophthalmia (sore eyes), anthrax.	Man, cattle and sheep.
2. Little fly, or gnat.	Hippelates flavipes . .	Pink eye..........................	....	School children.
3. Itch mite......	Sarcoptes scabei.....	Seven-year itch, suppurations, running sores.	Leprosy......................	Man, children.

ACTIVE CARRIERS.

Which may be intermediary host of disease germ or necessary host, in which the organism undergoes a developmental cycle.

4. Mosquito......	Anopheles, maculipennis, stegomyia calopus, culex fatigans, stegomyia fasciata.	Malaria (ague or chills and fever), yellow fever, dengue or breakbone fever, elephantiasis, kala azar, dumdum fever of India.	Rocky Mountain or spotted fever, Delhi boil, leprosy, Malta fever, chorea.	Man, children, bat, wild mammals, goat.
5. Ticks..........	Margaropus annulatus, dermacentor venustus, ornithodorus moubata.	Texas fever, Rocky Mountain fever or spotted fever, relapsing fever, African tick fever.	Bubonic, surra...............	Cattle, man, small wild mammals, rodents, horse, mule, camel, elephant, dog.

6. Lice..........	Pediculi capitis and vestimenti.	Typhus fever, Mexican typhus, relapsing fever.	Surra......................	Man and rodents.
7. Flea of man, rat, mouse, cat, dog, ground squirrel.	Pulex irritans, læmopsylla cheopis, c. fasciatus, p. serraticeps, c. musculi.	Bubonic plague or black death..	Surra, infantile paralysis, inf. kala azar, leprosy.	Man, infants.
8. Tsetse fly (pronounced Tset'ze).	Glossina palpalis, glossina morsitans.	Sleeping sickness of Africa......	Nagana (an epidemic disease of Africa identical with surra of Asia).	Man, antelope and wild pig, horse, camel, dog.
9. Sand fly.......	Phlobotomus, simulium reptans (Italy), simulium vittatum.	Dengue or breakbone fever, pappataci fever of Italy. a fatal malaria.	Pellagra....................	Man.
10. Buffalo gnat, or black fly.	Simulium sp.........	....	Infantile paralysis (Iowa state board of health).	Children.
11. Biting stable fly.	Stomoxys calcitrans.	Epidemic poliomyelitis (infantile paralysis).	Surra......................	Man, horse, monkey, mule, camel, elephant, cat, dog.
12. Bedbug.......	Cimex lectularius...	Bubonic plague, kala azar, the black or dumdum fever of India and Italy, tuberculosis, leprosy.	Epidemic poliomyelitis (infantile paralysis, beri-beri, relapsing fever.	Man.

TWO FLIES OF MANY WHOSE LARVAE FEED ON MAN.

13. Screwworm fly, or gray fly.	Chrysomyia macellaria.	Deposits eggs on wounds or in ears or nostrils of sleeping children or adults. Larvae burrow on hatching, causing great pain, and sometimes death.	Man.
14. Congo floor maggot.	Ochromyia anthropophagi.	Fly deposits eggs in cracks of floor. Hatched larvae suck blood of sleepers at night.	Man.

panying fleas, it spreads with great rapidity. The disease is also very fatal to rats, which during the epidemic die by the thousands.

When a rat dies its infected fleas seek another host. Preceding the outbreak of plague among the people of a community a large number of dead rats are generally seen lying around. A rat-ridden city, where plague is not far off, is like a lumber pile with kindling wood and coal oil-soaked paper under it ready for the application of a match in the form of an infected rat brought in by railroad, vessel, or other conveyance.

Typhus fever is an infectious disease transmitted by the body and head louse of man. This disease used to be very prevalent, but modern sanitary methods have almost eliminated the louse, and with it this disease. However, experience in the European war has shown that troops in the trenches can become infected with these insects, and that typhus fever gets in from some source.

The establishment of shower baths, places for the men to wash their clothes, and centers where clothing can be fumigated on the large scale, have stamped out this disease.

Kala azar is a disease of India characterized by emaciation and anemia, and finally death. It is transmitted by the bedbug. Avoidance of native buildings and scrupulous cleanliness about buildings and beds prevent the spread of this disease.

Sleeping sickness, or trypanosomiases, is a disease of the west coast of Africa and transmitted by the tsetse fly. The symptoms are fever, headache, and slowly developing mental weakness with a tendency to sleep all the time.

Leprosy is by some authorities supposed to be transmitted by the bedbug. The symptoms are chronic sores, paralysis, and loss of feeling.

Diseases due to improper food.—The body requires certain quantities of each of the three varieties of food: proteids, fats,

and carbohydrates; and there must be a certain amount of fresh food. Lack of proteids will cause a disease called beri-beri, which is characterized by dropsy, paralysis, and weakness. Lack of fresh food will cause a disease called scurvy, which is characterized by anemia, weakness, bleeding from the gums, and dropsy. Avoid the prolonged use of canned, dried, or preserved food, and provide as large a variety as possible. The conveying of fresh food in cold storage has eliminated these diseases to a great extent.

Diseases transmitted by milk.—This article of diet is the most easily infected of all foods, and therefore should always be selected with a great deal of care. In fact, where it can only be obtained from a doubtful source, it should either be eliminated or otherwise boiled before drinking. Goats' milk transmits a disease extremely prevalent along the Mediterranean shores called Malta fever. It is a disease something like typhoid fever.

It will be seen from the foregoing that the prevention of disease requires a close supervision of everything that pertains to the quartering, provisioning, and policing of a command. It includes everything from personal cleanliness to sanitary construction and sanitary engineering.

CHAPTER V.

VENEREAL DISEASES.

Venereal diseases are diseases that are transmitted during sexual contact.

It is possible to contract them under other conditions, but not probable.

Their spread is caused by promiscuous sexual intercourse, and without this they would die out and disappear. If all the people of this earth were to remain virtuous for one or two generations it is probable that venereal diseases would be stamped out for good. The germ would die, and it would take more than a thousand years of filthy and immoral living to develop a new species.

Venereal diseases are a legacy handed down by our forefathers, and have probably taken many centuries to develop to their present state of virulency, centuries of immoral living, due, perhaps, to ignorance; let us hope so at any rate, and that we of this enlightened age will, knowing the cause and the method of prevention, stamp out this greatest of all plagues.

Just what are venereal diseases? There are three of them, each due to its specific germ. These germs, or microbes, or bugs as they are commonly called, are like the germs of diphtheria or smallpox. They are living organisms, which multiply as a flea or a dog or a cow, always producing their own species; in other words, if you come in contact with one of the three of these venereal diseases you will contract that particular one, and it will be the one you will transmit to another person should that person be so unfortunate as to come in close contact with you.

These diseases through ignorance, not so much ignorance of their presence as ignorance of their terrible effects, have been transmitted from person to person until there is probably not a spot on the earth where large numbers of human beings live that they do not exist.

It is impossible for you to go anywhere and pick out a woman who will have illegitimate intercourse and not run a great risk of becoming infected. No matter how angelic she may appear, she is a dangerous proposition if she will let you have sexual intercourse without marriage.

Prostitutes are women who practice illegitimate intercourse as a means of livelihood. They often have themselves examined by a doctor, who gives them a certificate stating that they are free from venereal contagion. Few reputable physicians will give this certificate, as it is almost impossible to be sure that a woman of this kind is free from disease. This even after a most thorough examination, and it is possible for a woman to become infected a few hours afterwards. Prophylactic treatment taken after intercourse has saved many a man from a life of misery, but it cannot be relied on as a sure method. There is no sure method.

Is sexual intercourse necessary for health and for proper manly development? Positively no. Improper sexual intercourse gains nothing for those who participate and causes loss of self-respect.

If a man with malice aforethought, or while under the influence of liquor, enters a disreputable place and comes in close contact with its inmates or surroundings, he will come away with many misgivings; for he realizes that there are numerous chances against him. If he escapes contracting one of the three venereal diseases, there are still the dozen and one infections of ordinary diseases, which are most likely to lurk in filthy places of this kind, to say nothing of bedbugs and certain kinds of body lice which he may carry home.

The sexual organs come under the class of those organs which functionate periodically and have a certain time in life for functionating: as, for instance, the thymus gland, which is active in children and disappears before puberty. The secretions of the sexual organs, when not expelled, are absorbed back into the system, and are supposed to accentuate the distinctive qualities of the male sex.

A knowledge of the three forms of sexual diseases further than before stated may be of help to impress their danger upon you. Their names are: Syphilis, Gonorrhœa, and Chancroid. All other names you have heard are complications of these three, as bubo, etc.

Syphilis.—The most damaging of the venereal diseases is caused by the spirocheta pallada, which first attacks the skin in the region where it comes in contact with it and causes a local sore. From this the germ enters the blood and is carried all over the body. The blood and discharges from sores, mouth, nose, and all parts of the body are infectious in a person who has syphilis, and they may remain so for many years.

"606," a new remedy, has made some wonderful cures, but it is by no means effective in all cases. Mercury is still used for its treatment. The usual curative process requires a few painful injections of "606," followed by a course of more painful injections of some salt of mercury covering a period of three years. An old saying is, "One night with Venus and three years with Mercury."

Gonorrhœa, caused by the gonococcus of Neisser, is a filthy disease with its profuse discharge of pus from the urethra. It is primarily local, but may spread by the blood and cause infection of various joints, and even of the lining membrane of the heart, which latter is quite a serious affection. It may be carried to the eyes, by carelessness, or failing to destroy all dressings; wiping parts with a face towel and using the same

afterwards for face, or allowing it to lie around where some one else may use it; failing to wash and disinfect the hands after dressing diseased member. Gonorrheal opthalmia has caused many cases of total blindness.

Chancroid is a local disease. It appears in the form of a dirty ulcer and may cause extensive destruction of parts.

Syphilis and gonorrhœa are not easily cured; both may leave a man damaged, and both may break out again after being apparently cured. Both may infect an innocent wife, and both may produce damaging effects in the offspring. Many a woman has suffered from the miseries of syphilis, through no fault of her own, and many a woman has gone to the operating table to have her sexual organs removed on account of the ravages of a gonorrheal infection. Syphilis in a parent often results in deformity and idiocy in the child.

In the navy, on account of the menace a man with venereal disease is to his shipmates, it is necessary for the medical officer to know about and control all venereal cases. Therefore severe punishment is meted out to those who attempt to conceal a venereal case.

The cultivation of pure thoughts and avoidance of temptation, cold baths, simple non-stimulating diet, vigorous physical exercise, and alcoholic abstinence will prove efficacious in overcoming desire.

CHAPTER VI.

NAVAL HYGIENE.

This will be taken up under the headings of vital statistics, air, water, food, clothing and personal hygiene, and the disposal of sewage and waste.

Vital statistics.—In the navy it is necessary to keep a careful record of all injuries, wounds, and diseases, and their origin, in order to give justice in regard to pensions. From these records are also compiled the vital statistics, which give the loss or damage to the navy during any given length of time by any particular disease or injury, or by all diseases or injuries together.

It enables the commander-in-chief to know how much loss to count on from this source. As, for instance: of one thousand men, fifty were sick during the year and were incapacitated on an average of twenty days each. This means fifty multiplied by twenty, or one thousand working days lost, or one thousand divided by three hundred sixty-five days equals about three men on the sick list all of the time during the year. This has to be counted on, as it leaves you nine hundred and ninety-seven men to do the work. Actual conditions would be above this, ranging from ten to two hundred out of a thousand on the sick list, depending upon whether serving afloat or on shore or in the tropics or temperate zone. Vital statistics are of use in preparing for a campaign, as, for instance, if you were in command of a ship or squadron and calculated it would take one thousand men to capture a city one hundred miles in the interior, and it would take twenty days to get there and fifty days for a siege; you would have to send in excess of one thousand in proportion to the expectation of incapacitation by disease; and this expectation would depend upon the climate, prevalence of disease, etc.

Vital statistics also are of use in correcting sanitary conditions.

Air aboard ship.—The subject of ventilation on board a ship is of vastly more importance than on shore, and the problem is far more complicated. One thousand cubic feet of space per man, and in this space a renewal three times an hour, is an arbitrary standard generally accepted on shore, but on shipboard, on account of the limited space available, two hundred cubic feet is allowed per man, and in order to deliver the required three thousand cubic feet per man, it is necessary to change the contained atmosphere every four minutes. This creates uncomfortable and dangerous drafts, which cause chilling with the resultant catarrhal diseases.

In summer or in the tropics, the question of delivery is all that has to be considered, and the effects of drafts are not so harmful; but in cold weather, where the air is delivered direct from the outside the crew are constantly coming in contact with cold blasts of air, and suffer with repeated attacks of colds in the head and chest.

Where the air is delivered already warmed its effects are not so bad, but unless moisture is added by passing the heated air over water before delivery there will still be ill effects due to the irritating effect of dry air on the mucous membranes of the nose and throat.

Three thousand cubic feet of air should be delivered per man per hour at the proper temperature (seventy degrees, Fahrenheit), and with the proper humidity. Each man should be allotted as much space for living quarters as possible, two hundred cubic feet being the minimum.

On shore, natural ventilation (that obtained by opening of windows) is all that is necessary; but on board ship, where the openings into compartments are so small, natural ventilation is not sufficient. Air has to be forced into the compartments by power-driven fans.

There are two forms of artificial ventilation: the supply system and the exhaust system. The former forces the fresh air into the compartment, the air already contained finding its way out through doors, ports, or other openings.

This method well ventilates the supplied compartments, but where it happens to be a toilet or bad-smelling store-room, foul air is driven through doors and cracks into adjoining compartments. The supply system should be used for living quarters, where pure air is most needed; and the exhaust system should be used for heads, store-rooms, and compartments that are not constantly occupied.

Water.—Since distilled water has come to be used altogether for drinking, cooking, and washing purposes on board ships, diseases from this source have disappeared. However, care should be exercised in keeping the drinking tanks clean, and where common drinking cups are used they should be kept immersed in an antiseptic solution, as common drinking cups are the cause of the transmission of a great many diseases, as syphilis, diphtheria, tonsillitis, etc.

Never by any chance let any dirty harbor water get into the drinking water tanks. It is best to avoid ever buying any water, even to fill the feed tanks; there are so many by-passes.

There are two water pipe systems aboard ship: the sea water system and the fresh water system. There is more danger than the simple salting of your fresh water by these two systems getting opened one into the other. The salt water system when in port contains disease-polluted water. Do not use polluted harbor water to wash down decks, as it may be a source of sickness.

Food.—In times past, when the sea ration consisted of hardtack and canned or preserved beef, scurvy, a disease caused by the lack of fresh food, was the cause of failure in many expeditions by sea. To-day, owing to cold storage, fresh provisions can be carried, and this disease is seldom heard of. The food

should be chosen to suit the climate and season of the year, and plenty of fresh meat, vegetables, and fruit should always be allowed. Although men can live on a poor ration, they cannot be so active mentally or physically, and their endurance is diminished.

Definition of food.—In its general sense, food may be taken to mean anything which nourishes the body. Such a broad definition would include the oxygen derived from the air we breathe. In its ordinary usage the term refers to materials voluntarily introduced into the body to support life.

In the normal processes of the body, tissues must be grown or rebuilt; waste must be repaired; energy must be created; heat must be supplied. Four elements—oxygen, hydrogen, carbon, and nitrogen—are necessary ingredients of all the tissues of the body. Nitrogen is essentially a tissue builder, the other three elements are force producers.

It is obvious that food must contain these elements in proportions at least approximating the needs of the body.

The great bulk of our food consists of substances containing carbon, hydrogen, and oxygen; in other words, the force producers. These substances are oxidized in the body, their end products being carbon dioxide and water, which are exhaled by the lungs. The nitrogen-containing foods are the tissue builders. They leave a residue of waste material in the form of urea and uric acid, which are excreted by the kidneys.

Classes of foods.—Substances used as food by mankind naturally fall under three groups in accordance with their chemical characteristics. These groups are: proteins, carbohydrates, and fats. The proteins are the nitrogenous foods, which have to do with repair and growth. Carbohydrates and fats are the heat and energy producers. In addition to these true foods, there are substances equally vital to life, notably water and mineral salts.

Examples of proteid food are: meat, fish, fowl, eggs, milk, peas, beans, and grain. Proteid food should make up about one-seventh of the ration. At least seventy grams (two and a half ounces) of the dried proteid is needed per man per day.

Examples of carbohydrates are: bread, potatoes, starch, sugar, etc. They should make up the large bulk of the ration.

Examples of fatty foods are: butter, fat meat, oils, etc. These should make up a small part of the ration in hot weather and a larger part in cold weather.

Clothing and personal hygiene.—The principal object of clothing is to regulate body temperature. The normal body is acting all the time to maintain a fixed temperature. It strives to have its loss of heat equal to its production of heat; and, where its surroundings tend to take away heat too rapidly, it diminishes loss by, among other things, limiting surface blood supply. But where its surroundings are themselves relatively warm, the body resorts to methods to facilitate heat loss; it increases the flow of its warm circulating fluid to the skin, it covers itself with water in the form of sweat, it avoids the neighborhood of objects warmer than itself, and seeks air in motion, in order that the sweat may be evaporated and that the particles of air streaming over the body may each carry away some amount of water and, therefore, heat in latent form.

Clothing retains body heat not only by reason of its own non-conductivity, but by reason of the non-conductivity of the air contained in its meshes and among the different layers of clothing; so that it will be seen that it is not entirely the material, but the weave also, which must be considered. The more air entangled in its meshes, the better non-conductor it will be.

As wetting of clothing causes it to be more conducting, substances which take up moisture more slowly from the skin or from the outside air will best retain heat.

Wool is the best non-conductor, cotton next, and linen next.

On account of woolens being always the best non-conductors, they are the safest to wear in order to prevent chilling. Even in the tropics light woolen underwear is most desirable. Cotton next to the skin is most comfortable; and on account of its power of absorbing perspiration rapidly it makes a comfortable undergarment.

Exposure of the body to heat, or production of excessive heat in the body by muscular exercise, will cause a diminished production of heat from the sources which keep up body temperature under ordinary conditions of rest where the surrounding atmosphere is cold. Hence, when coming from a warm house out into the cold, or after heavy exercise, the regular heat source which heats the body at all times, whether at rest or work, is temporarily stopped; and before it has time to get started the body temperature may fall below normal; that is, the body becomes chilled. On coming from a warm house out into the cold, or after being overheated by exercise, always put on a coat or sweater.

Barring conditions of excessive humidity, the body is able to maintain its normal temperature (ninety-eight and six-tenths degrees, F.) where the surrounding atmosphere ranges from zero to one hundred and forty or more degrees, Fahrenheit.

It is not the cold that produces chilling and its consequences, but sudden changes and the exposure to different temperatures on different parts of the body at the same time; as, for instance, a cold draft of air on the back of the neck, which will produce a local stiffness of the muscles. Avoid sudden chilling and drafts.

When overheated and drenched with perspiration, dry off and change clothing.

Humidity of the air and wet clothing interfere with heat regulation. It is sometimes impossible to avoid a humid atmosphere, and under such conditions, if in cold weather, extra clothing should be put on; and if in hot weather, avoid fatigue. It is very hard for the body to compensate for the last

condition; all that can be recommended is a shady spot, cooling drinks, and a fan. Where clothing is wet, and active work is being done, chilling is not so likely; but immediately after the work is finished the body should be wiped off and dry clothing be put on.

Personal hygiene.—As regards personal hygiene, too much importance cannot be attached to this subject aboard ship, where men are living in close contact in confined spaces.

It not only has an æsthetic side, but is the means of preventing the entrance and spread of a great many diseases. A clean ship and a clean personnel go hand in hand. Bedding and clothing must be frequently washed and aired, and the bodies must be washed every day. Vermin and disease cannot live where cleanliness is the watchword.

Waste and sewage.—The disposal of waste and sewage on board ship require careful supervision. Heads are in close proximity, and if not properly flushed will be a source of great discomfort, and may cause disease.

The heads for the crew have trough water closets, in which a constant flow of water should be maintained. The wooden seats should be easily removed and should be scrubbed each day. The deck should be tiled and should receive a thorough washing every day. Frequent treatment of seats, bulkheads, troughs, and decks with some antiseptic solution should be carried out. All plumbing about the heads should be frequently inspected, and any leaks stopped at once.

Garbage and fluid waste from the galley and pantries are disposed of by throwing overboard, except alongside of dock in port, where they are removed by the garbage lighter. These compartments must be kept clean and free from refuse, in order to prevent the breeding of vermin.

There is no place where men live in such close contact and where filth and disease can develop so rapidly as on board a ship at sea, and the price of health and comfort is eternal vigilance in carrying out sanitary measures.

CHAPTER VII.

MILITARY HYGIENE.[1]

Camp diseases are preventable; their presence in a command means that the laws of hygiene have been violated. Deliberate disregard of sanitary regulations is a grave military offence, and should be dealt with accordingly.

In ordinary campaigns sickness disables from five to ten times as many men as wounds.

In a modern engagement it requires, on an average, an expenditure of from 200 to 400 rounds of ammunition for each one of the enemy to be put out of the fighting, and considering the number of rounds carried, this expenditure represents the effectiveness of from one to two men.

When it is realized that but a single cupful of polluted water may be equally damaging by rendering a fighting man unfit for duty for many weeks, if he survives at all, and may be the means of spreading disease far and wide in a command, then the great importance of faithfully observing hygienic precautions will be appreciated.

On board ship sanitary regulations can be effectively enforced, but on shore, with the changed conditions, the maintenance of the highest efficiency of the command is dependent upon the cooperation of each individual of that command.

The landing force should be prepared to combat disease-producing conditions wherever they may be encountered, whether it be in the jungles of the tropics or in great cities.

[1] Taken from Notes on Military Hygiene in the Landing-Force and Small-Arm Instructions, U. S. Navy, 1916.

Preparatory.—The following individuals should be excluded from landing parties:

Men afflicted with venereal disease.

Men whose feet are deformed or sore from blisters, chafes, corns, callosities, bunions, or hammer-toe.

Men under 20 years and over 45 years, with few exceptions.

Men convalescing from disease or injury.

Men with badly decayed teeth, men with diarrheal diseases, and obese men.

Physical betterment.—Officers and men should take part in all physical drills, and should, when expedient, encourage and engage in athletic sports. These sports not only better men physically, but they develop a spirit of comradeship that is of inestimable value.

Practice marches on shore and with the men not under restraint should be undertaken regularly. This exercise would greatly improve the physically fit and would enable the medical officer to weed out the undesirable.

Gymnastic exercises and track events, also boxing, wrestling, swimming, boat-racing, baseball, and football should form a conspicuous part of service in the navy. These sports, when engaged in under intelligent supervision, not only raise the physical standard of the officers and men, but their mental and moral tone as well.

Care of the feet.—Neglect of the feet should be considered a punishable offence.

Shoes.—The shoe is the most important single article of uniform. The regulation shoe should be worn without exception, unless on the advice of a medical officer.

A good marching shoe should be large enough in all directions, but not too large. If the foot moves in the shoe it is apt to chafe and blister. A common defect in shoes is that they are too tight over the instep and too loose across the ball of the foot. If the leather forward of the instep is too slack, wrinkles

will form. Folds of leather and rough inner seams should be avoided. The inner edge of the shoe should be straight, the sole thick and wide, projecting beyond the upper leather. The heel should be low and broad, and the toe of the shoe should be of such a length that there will be no pressure on the ends of the toes or toe-nails.

The toe-nails should be cut straight across, a little behind the end of the toe, and should not be rounded. Any tendency to ingrowing should receive treatment at once.

Corns and callosities are due to pressure and friction from unhygienic shoes. When between the toes they are soft; on other parts they are dry and hard. They often render men unfit for duty.

Treatment: Remove the cause by wearing hygienic shoes. Soak the feet well in hot water, then pare the corn or callous down with a sharp knife, a fragment of glass, or with sand-paper, without wounding the skin. Soft corns should be treated by applying a dusting powder like aristol on cotton or gauze between the toes.

Salicylic-acid treatment: Apply the following collodion paint with a camel's-hair brush, night and morning, for several days, then soak the feet in hot water and the corn will come away painlessly.

Acid salicylic	dram 1
Extract cannabis indicæ...............	grain 20
Collodii	ounce 1

M. S. Corn paint.

Blisters.—Save the skin; drain at the lowest point with a clean needle; or better, pass a threaded needle through and tie the thread ends, later cutting the ends and leaving the thread in the blister to come away with the skin. Protect with cotton and rubber-plaster.

Excessive and foul perspiration.—Excessive perspiration often leads to foot-soreness, blisters, fissures, and corns, and may be offensive.

Mild cases will be relieved by dusting into the shoes and onto the feet the following "foot-powder":

Acid salicylic	3 parts
Pulvis amyli	10 parts
Talci	87 parts

This foot-powder may be used with benefit before a march, especially in cases of sore and tender feet.

Severe cases will be relieved by soaking the feet, after a preliminary scrub with soap and water, in a solution of permanganate of potassium. The stain should be left on the feet. The solution should be gradually increased from one per cent to six per cent, and the treatment continued nightly for three weeks. The foot-powder should be used during the day.

Another method: Sprinkle a few drops of formalin in the shoes each morning.

Before a march the feet should be well greased with tallow or neat's-foot oil, or the inside of the stockings should be covered with a stiff lather of common yellow soap well rubbed in, or the foot-powder may be used.

On the march, should the stockings cause pain, the pressure is sometimes relieved by shifting them to the opposite feet, or by turning them inside out. Within two hours after reaching camp the feet should be wiped off with a wet cloth, clean stockings put on, and those which are removed washed for the following day, if possible.

To toughen the feet.—Men unaccustomed to marching may toughen their feet by soaking them in strong, tepid alum water (a teaspoonful to a pint).

Care of the mouth.—Mouth-breathing induces sore throat, diseases of the nose and ears, and causes thirst. Nose-breathing is normal and should be employed at all times.

The teeth.—The teeth should be brushed night and morning. Decayed teeth should be filled or pulled, as they are apt to induce abscess of the jaw, indigestion, debility, and diarrhœa.

The proper chewing of food is more important than the kind of food chewed. Thorough chewing makes food nourishing, prevents hunger, and diminishes thirst.

Drinking cups.—Common drinking cups on board ship and in camp are sources of great danger through spreading disease. When not in use they should be kept submerged in formalin solution (1-1000). Where common drinking cups are not disinfected, lip-drinking, which consists of putting both lips, horse-fashion, into the fluid to be drunk, should be practiced.

Thirst.—The habit of abstaining from drinking water on the march is an excellent one, and can be acquired readily. Thirst sensations lie in the back of the throat and may be relieved by carrying any small object, as, for instance, a pebble, in the mouth.

Boiled water may be drunk at the start and near the end of the march.

Canteens should be carried filled.

Bathing.—A daily bath and rub-down is desirable. The hair should be cut close, and the head washed daily.

On the march the feet and groins, as well as the armpits, genitals, and anus, should be cleansed even though only a damp cloth is available. After reaching the camp the more completely a person is bathed the better.

On the march and in camp.—A marching column is a healthy column. Sources of danger to a column are mosquitoes, flies, dust, water, food, drinking cups, and climate. How to avoid these dangers is given below.

Mosquitoes.—Mosquitoes transmit malarial and yellow fevers and other germ diseases. In the tropics these diseases may prove rapidly fatal and hopelessly cripple a command. Preventive measures are:

Mechanical.—By the use of screens, netting, etc.; the destruction of mosquitoes and their larvæ, and the prevention of their growth.

Medicinal.—Malarial fever is transmitted by the bite of anopheles mosquitoes alone. These mosquitoes become dangerous about five days after sucking the blood of infected persons, otherwise they are harmless; it follows that malarial patients should be screened with netting and actively treated with quinine to prevent the spread of the disease.

The best way to rid a region of malaria is to treat with quinine all persons infected in that region. In some districts over fifty per cent of the natives are afflicted. For this reason camps should not be established within half a mile of villages, and under no circumstances should native houses be occupied.

From three to five grains of quinine taken daily will greatly reduce the chances of becoming infected with malaria. Screens, netting, and other mechanical devices should be used wherever it is possible to employ them. They protect the well and prevent the sick from spreading the disease.

Destruction of mosquitoes and their larvæ and the prevention of their growth.—Mosquitoes breed in water lodged in eaves-troughs, barrels, tin cans, broken bottles, footprints, stagnant pools, ponds, and swamps. They hide during the day and are active only at night, unless disturbed. The females alone bite. A single female lays between 200 and 400 eggs, and the laying and hatching continue from early spring until November. The eggs develop in three days into wigglers (larvæ), which in turn become tumblers (pupæ) in sixteen days. The pupæ, or tumblers, become full-grown mosquitoes in about five days, the whole covering a period of about three weeks.

Drying kills the eggs, wigglers, and tumblers; petroleum promptly kills the insects in all stages.

Do away with all unnecessary water containers. Drain or fill in all ponds, pools, and swamps, if possible. Treat all standing water with petroleum at least three times in two months, using the cheap oil, two tablespoonfuls to 15 square feet of surface.

To remove mosquitoes from dwellings.—Close and seal the doors and windows. Burn at night three pounds of sulphur for every 1000 cubic feet of space.

Pyrethrum (insect) powder, when burned at night, will stupefy the insects and they can be swept out in the morning.

Camp-fires attract and burn mosquitoes.

Yellow fever is transmitted by the bite of stegomyia mosquitoes alone. These mosquitoes become dangerous about twelve days after sucking the blood of persons ill with that disease.

Quinine is without effect in yellow fever.

Directions: Screen all patients to prevent the contamination of mosquitoes. Screen all others to prevent them from being bitten. Destroy these mosquitoes as directed under malaria. If yellow fever breaks out, the camp should be moved at once.

Flies.—The germs of many diseases, such as typhoid fever, dysentery, cholera, and diarrhœa may be carried on the feet of flies from sinks and urinals to uncovered food, water, and food receptacles.

The sinks and kitchens should be as far apart as possible, sinks to leeward.

The food and drink, after cooking or boiling, as the case may be, should be carefully protected from flies.

A single female fly lays about 120 eggs, which mature in about ten days. The eggs develop best in putrid organic matter, in sinks, in polluted soil, and in manure.

A clean, sanitary camp, properly policed, is the remedy.

Dust.—In insanitary camps, not properly policed, dust may carry dried filth, laden with the germs of disease, to be breathed or eaten as the case may be.

Destruction of camp refuse; cleanliness; the proper care of the urinals and sinks, and the selection of suitable camp sites are the remedies.

Water.—All drinking water must be boiled or distilled and afterward protected against contamination.

Roadside water and raw water from streams, wells, and badly-kept springs is commonly polluted with the germs of typhoid fever, dysentery, cholera, and diarrheal diseases, and should be avoided. Boiling destroys these germs and renders water fit for drinking and cooking purposes.

On going into camp the water supply should immediately be placed under intelligent supervision, and its approach protected by boards, rails, or logs, even in temporary camps.

The water supply.—Physical characteristics of good water: Good water is colorless, clear, free from suspended matter, of brilliant luster, devoid of smell or taste except that recognized as belonging to good water.

Physical characteristics of bad water: Bad water may occasionally have all the characteristics of good water and still contain the germs of disease. Any departure from the characteristics of good water, especially undue turbidity, or the development of odors on gentle warming, should cause it to be treated with suspicion.

Sources of water.—Good: Rain-water, water from clear ice, lakes, large rivers, and streams in uninhabited districts, artesian wells, and protected springs. Bad: Rain-water from polluted surfaces, snow-ice, small ponds, small streams and wells in inhabited regions, marsh-water, and rivers below towns and cities.

How to cool water.—Suspend it in air currents in porous earthen jars, canvas bags, or in other receptacles wrapped in wet fabrics.

How to clear turbid water.—Add from five to ten grains of alum to the gallon of water before boiling.

How to clear muddy water.—Prepare a double barrel or box as follows: Into the larger barrel or box place sand, pebbles, charcoal, etc.; it should receive the muddy water. The small

barrel or box, with a perforated bottom, rests inside the larger and the clear water passes up into it.

Food.—Food and food containers contaminated by flies and germ-laden dust are the most common sources of camp diseases, such as typhoid, cholera, and dysentery.

Beverages.—Uncooked milk and "soft drinks" should be treated with suspicion.

Fruit.—If it were possible to select fresh, ripe, sound, and scrupulously clean fruits, they might be eaten with benefit. The danger lies in unripeness, staleness, commencing decomposition, and surface germ-contamination.

Salads and other raw food from the surface of the soil are especially dangerous.

Precautions.—It is safest in camp to interdict raw foods and beverages without exception. Thorough cooking removes all danger from germ-contamination.

Cooks.—Efficient cooks, drilled in the proper method of keeping, preparing, and cooking food, and cognizant of the importance of intelligently cleansing and caring for food containers, and the preparation of drinking water, should accompany the landing force. Badly cooked food and dirty food containers cause digestive and diarrheal diseases. All food should be carefully screened, covered, or otherwise protected from dust and flies from the time it is cooked until it is eaten. Uncooked and badly exposed food should not be eaten.

Drinking cups.—Drinking cups, eating utensils, lead-pencils, plug tobacco, and the like should not be passed around. They have been known to spread contagious diseases like syphilis, diphtheria, mumps, and measles.

Common drinking cups at scuttle-butts and elsewhere should be kept submerged in formalin (1-1000) when not in actual use. The Gates bubbling fountain should be attached to all scuttle-butts.

Lip-drinking, horse-fashion, should be practiced where the cups are not disinfected.

Climate.—Extremes of heat and cold are rarely causes of sickness in themselves, if camp sites are well chosen and sanitary regulations are intelligently carried out.

The men should not sleep directly on the ground if it can be avoided. They should raise their beds with straw, leaves, boughs, or other means.

Badly selected camp sites may, through dampness and other avoidable climatic influences, be responsible for pneumonia, bronchitis, colds, sore throat, and rheumatic affections.

Wet clothes.—Little harm comes to men with wet clothes and wet foot-gear if they are exercising actively.

Chilliness from extreme cold or inactivity is dangerous.

In the tropics.—In the tropics there should be moderation in diet, drinking, exercise, clothing, and work.

The abuse of alcohol is most dangerous to health.

The diet should be light and nutritious, much the same as at home, but diminished in amount.

Sports, in moderation, should be encouraged for recreation. Swimming is a healthful tropical exercise.

Exposure of the head, neck, and spinal column to the direct rays of the sun is particularly harmful and should be avoided.

There should be no hard work or exhausting drills between 8 a. m. and 4 p. m. During these hours necessary work only should be undertaken.

Chilling of the person, especially of the abdomen, should be avoided. Suitable covering at night not only protects the individual from the sudden changes of temperature incident to the tropics, but also against the bites of insects.

Camps and camp sites.—Old camp grounds should be avoided whenever possible. Wood, water, and grass should be available. A southern slope and high, well-drained ground are desirable.

The driest site is the best. A side hill is warmer than the top and drier than the bottom.

Grass land generally is a good camping ground, but rank vegetation in the tropics means a damp soil.

The soil should be dry and porous.

Clay and other soils of low permeability to air and moisture should if possible be avoided. They are retentive of water and cold, and cause dampness of the atmosphere. Old river-bottoms, marshy ground, and land subjected to periodical flooding, especially by salt water, are undesirable.

Winds.—The camp should be so placed that the prevailing wind will blow toward possible breeding places for mosquitoes and will not blow dust and flies from the sinks toward the kitchens.

Sinks.—On halting for the day the first duty is the posting of sentries over the water supply and the designating of a place for relieving the calls of nature.

The first task should be to dig the sinks.

If the force is small and the camp is reached after dark and it is to be broken early next morning, then sinks need not be dug. The men should use a designated place and should cover their evacuations with earth.

Sinks should be two feet wide at the top, twelve to twenty feet long, and from three to ten feet deep in proportion to the probable length of stay. The earth should be thrown to the rear, and a layer of a few inches from it covered in at least three times a day.

Shallow sinks should be filled in when they reach within a foot of the top; deeper sinks at a lower level.

All sinks should be re-covered and marked on breaking camp.

A pole on forked uprights makes a satisfactory seat. Each man should cover his evacuations with earth.

Straw or paper saturated with kerosene, or kerosene alone, should be burned in the sinks at least twice a day when practicable. Quicklime thrown in to cover the passages is also

effective. Earth, kerosene and quicklime should all be used, when possible, as no one alone is entirely satisfactory.

These measures greatly diminish the number of flies about camp, and prevent the spread of camp filth and disease by these pests.

The sinks should be so placed that prevailing winds blow across the camp toward them; so situated that they cannot pollute the water supply, and located as far away from the kitchens as possible, yet not at such a distance as to tempt men to pollute the soil at more convenient points. They should be screened by bushes.

A number of sinks are better controlled than a single large one.

Urinals.—Urinals should be conveniently located and kept under control to avoid soil-pollution. They should be quick-limed and kept covered.

Typhoid-fever germs often abound in the urine as well as in the bowel discharges.

Filthiness in camp is an offence against health as well as an offence against decency.

Kitchen pits.—Pits should be dug at once for the purely liquid refuse from the kitchens. They should be located in the vicinity of the kitchen, and should be covered with boards or other material to exclude flies. If boards are not to be had, brushwood, straw or grass, or something of the sort, supported by saplings laid crosswise, will answer. If possible the openings for the slops should be guarded with wire mesh and covered with boards. The pits should be treated with kerosene from time to time, and should be filled in before marching.

Unless the pits are guarded, flies will breed in them and will swarm about the kitchen and camp.

The solid kitchen refuse should be burned daily.

In temporary camps the kitchen fire may be used for the purpose. In more permanent camps the solid refuse should be removed to a designated place and there destroyed by fire.

CHAPTER VIII.

PHYSICAL TRAINING.

No authority has ever contended that physical culture of some form was not conducive to stronger and better manhood, but the question has arisen of late years as to whether certain forms of contestant athletics do all that is claimed for them in the way of cultivating a spirit of good sportsmanship, self-reliance, endurance, and ability to undergo hardships and adversities "like a man"; and whether they lead to ill effects at the time or in later life. As to the former, it is extremely hard to gather statistics which will show that athletes of the contestant type have shown up better in after life in the characteristics above mentioned; but we could reasonably expect that boys who had learned to stand pain and fatigue and defeat with a proper spirit would in later life be better fitted to stand the ups and downs without giving a call for help, and that they would be the last to admit defeat and the first to take up the flag and make another try onward. As a class the athlete is the stronger character; bigger hearted and cleaner minded than other men.

In regard to the ill effects of athletics: It is true that there are many which occur every year; but a majority of them could be eliminated by proper medical supervision. Injury due to excessive strain on the heart or other organs can be nearly entirely overcome by weeding out the diseased, warning against heavy exercise after eating, and over-training, etc. Direct injuries to parts of the body during the contest cannot be entirely stopped, but the after effects can be greatly minimized by prompt removal from the game and immediately started careful treatment.

A boy should not be allowed to stay in training over from one to four months, depending on his age, during any one year.

It has been said that athletics of the contestant type have a tendency to further develop the few, or those who are already of good physique, and to leave on the side-lines to cheer the large majority who are under-developed. Why not? If we have strong men, let them develop into still stronger men. Contestant athletics do not prevent those who do not or cannot enter them taking exercises of their own to suit their needs.

Every educational institution should have facilities for as many different athletic sports as possible and some form of compulsory physical drill. All contestants should be examined by a physician before entry into and during participation in sports. Exercises should be prescribed for those who are under-developed.

Men who are well developed physically but deficient mentally should be made to give more time to their mental and less to their physical development.

Men who are deficient physically and mentally had best first become physically efficient.

Every human being is born with a natural craving for bodily activity, and since the growth and development of the entire human organism is determined by the manner in which this craving is satisfied, it is necessary that it should conform to some well-defined and well-regulated method.

A rational course of physical training must have for its primary object the development of the human organism in its entirety. That is, a man should exercise each and every muscle with a view to symmetrical development.

Every muscular effort calls for increased respiratory action; this is due to the fact that upon the respiratory system devolves the duty of supplying the blood with oxygen.

Exercise is a powerful stimulant to the heart, and, since this organ is a muscle, it grows in strength in proportion as the body grows, and declines in proportion as the muscular system is allowed to decline. It is so closely concerned with every effort and so vital to well being that it must be considered in connection with all forms of athletics.

By judicious exercise the heart may be developed until it is capable of responding to tasks that would result disastrously without this preparation.

When it is a question of the ability of the heart to cope successfully with the strain that is intended to be placed upon it, it is always well to err upon the side of safety.

Too many men go in for heavy athletics who are not properly fitted for them, or without proper and sufficient training. After a period of inactivity the heart, like the rest of the muscular system, even in the well developed, becomes soft and flabby; and any excessive strain on this organ at such a time is likely to produce permanent injury by over-distension and stretching of its fibers, or rupture of one of its valves. On the other hand, the human organism has a limit to its power of endurance, and constant training with the idea of keeping at all times in the pink of condition will bring about a condition just the opposite to what a man is striving to attain; the power of endurance will be lessened and instead of a man being able to accomplish more and more from day to day or month to month, he will find himself growing weaker, less active, and less anxious to get into the game. He has no "pep," because he is going stale. He should break training for a while and rest up. By so doing he will more than make up for the time lost from training.

It is surprising how much good a man will get out of a break in training when he finds that he is not making headway.

The athletic sports which require the heart to work at its full capacity, and which might cause injury to this organ when not in training or when diseased, are:

Crew racing
Sprinting and long-distance running
Football
Contestant swimming
Basketball
Boxing and wrestling
Lacrosse
Violent tennis, especially in very hot weather.

There are two kinds of injury to the heart: one produced by a short, violent effort, causing rupture of one of the valves, with permanent injury or immediate death; the other produced by prolonged violent effort and causing a dilatation of the heart with stretching of its fibers and permanent injury.

CHAPTER IX.

FIRST AID.

It is the duty of every officer and man to familiarize himself with the details of first-aid, so that he may be able to give efficient help to fallen comrades, and in case of necessity direct or assist in efforts made in his own behalf.

By first-aid is meant the measures that should be employed in the immediate treatment of gunshot wounds and the various accidents and emergencies incident to military service.

Measures of treatment may be grouped under the following heads:

Shock and its treatment.

The resuscitation of the apparently drowned, those poisoned by noxious gases, and those suffocated from other causes.

The treatment of accidents and emergencies.

The checking of hemorrhage.

The application of first-aid dressings in gunshot wounds.

The preparation of the wounded for transportation.

Shock.—This condition will be discussed first, as it is more or less present in every form of injury, whether it be the sting of a bee or an extensive wound.

The so-called kinetic theory of shock is the latest, and is generally accepted as correct. It defines shock as an exhaustion due to excessive conversion of potential or stored up energy as a result of stimuli received and transmitted to our consciousness through the medium of various forms of nerve endings, to which has been given the name of nociceptors, or ceptors which receive nocuous or harmful influences. These nociceptors may be the simple contact ceptors located in the

[1] Portions quoted from First-Aid, Landing-Force Instructions.

skin, or they may be specialized ceptors to be found in the special sense organs or situated in any cavity or tissue from which, on account of our evolutionary environment, we are in the habit of receiving notification as to the presence of injurious agencies or processes. Thus an environment or association which might result in injury to our health or life would be a nocuous association; and the converse of this condition, in which no harmful influences are present, has been given the name of anoci-association, which indicates a freedom from all injurious factors.

The harmful stimuli which are received and transmitted by the ceptors are immediately recorded in various cells of the brain, which latter reflexly activate the cells of certain other tissues with the idea of combating or otherwise offsetting the presence of the particular harmful condition or association. This response to the presence of some injurious agency is usually manifested in the form of muscular activity, since it is through our muscular system that we are able to escape from situations or conditions which the prolonged evolution of the race recognizes as harmful. Thus: should we suddenly come in contact with a red-hot iron or a sharp piece of metal we immediately call into action certain muscles which bring about the movement necessary to rid us of the painful, and therefore harmful, influence. These responses to stimuli and the resultant action call for the expenditure of energy, or the vital force represented by a certain chemical compound, which is stored up in the cells of the brain, liver, suprarenals, and muscles. When this expenditure of vital force is prolonged or excessive, an exhaustion of these cell storehouses or magazines is bound to occur; and this exhaustion, whether physical, emotional, or otherwise, we designate as "shock."

When a sudden violent injury occurs, the stimuli are overwhelmingly intense; and the kinetic system, represented by the organs named—especially the brain—is profoundly ex-

hausted, or even permanently injured, by reason of a sudden discharge of a large amount of stored-up energy in the futile and involuntary effort to bring about a correction of the condition causing the injury. This sudden exhaustion of the kinetic system we call acute shock, but if the stimuli extend over a period of time, and are not so intense as to cause an immediate breakdown, there may be a gradual exhaustion of the kinetic system which, though chronically induced, is to be regarded as shock. In other words, the activation of the kinetic system to the point of exhaustion, whether due to sudden or prolonged injury, is represented by the term "traumatic" shock. The changes leading up to this condition may be started by emotion, carried a step farther by muscular exertion, another step by physical injury, another by hemorrhage, and so on until destroyed; or all the factors acting simultaneously may produce the same disastrous result.

The symptoms of shock are rapid, weak pulse; pale, pinched face; cold, clammy skin, and rapid shallow breathing. The subject is conscious, but takes no interest in his surroundings; he is apathetic and exhausted.

The treatment resolves itself into the prevention of further shock by anoci-association and the support of the circulation.

In order to produce a condition of anoci-association, give morphine to relieve pain, place in as quiet and cheerful surroundings as possible, keep warm with blankets and hot water bottles or hot bricks. Dress wounds as quickly and gently as possible. In profound shock give no local treatment further than arrest of hemorrhage and do not move or disturb patient any more than absolutely necessary for his own safety and comfort.

To support the circulation, first stop any hemorrhage; then give hot drinks, tea and coffee, or hot water. Give a hot enema, no hotter than the hand will bear for one minute.

The resuscitation of the apparently drowned.—Persons in

distress in the water should try to throw themselves on their backs in order to float in that position, or should seek support from objects close at hand. As a rule it is a mistake to try to swim to the shore.

In approaching drowning persons, swimmers should get their attention and reassure them by calling in a loud voice that assistance is at hand. Approach a drowning person from behind, seize him by the hair if possible, and turn him on his back in front of you, while you yourself assume the same position in the water, keeping both heads a little above the surface by an occasional kick.

Persons apparently drowned are suffering not only from the suffocating effects of water, but, usually, from exhaustion caused by struggling, and shock from fright and cold, as well. They should be promptly and gently removed from the water, and efforts at resuscitation should be begun instantly.

To remove water from the lungs.—Remove shirts; lay the patient on his face; clasp your hands under his abdomen and raise him in order to drain water from his lungs and air-passages.

To clear air-passages.—Turn him on his back quickly, placing a rolled shirt under his shoulders, and thoroughly wipe out his mouth and nose. Pull his tongue well forward and tie it against the lower teeth by passing a shoestring or rubber band over it and under the chin, or hold it forward with a handkerchief.

To restore breathing.—First motion: Rest on one knee behind the head, seizing both forearms above the wrists, thumbs pointing inward; sweep them away from the body and over the head, at the same time rising and leaning back so as to make a strong pull on them for a couple of seconds, bracing with a foot against the patient's shoulder.

Second motion: Rise quickly and, leaning over the patient, still grasping the forearms, bring them across the lower part

of his chest, making strong pressure with your weight against his lower ribs, which drives the air out of his chest. This motion should occupy but a second of time.

Repeat these motions about fifteen times a minute until breathing returns.

Efforts at resuscitation should be kept up for at least half an hour.

All wet clothing should be removed while artificial respiration is being practiced, and the body and limbs should be rubbed toward the heart. Blankets should be wrapped about the patient and warmth in the shape of hot bottles, hot bricks, hot sand, or a hot board, that may have lain in the sun, should be applied.

Do not give stimulants before the patient can swallow. Do not remove him until he is conscious and is breathing naturally.

Suffocation.—Suffocation from foreign bodies in the windpipe, from hanging, and from the inhalation of poisonous gases, is treated by removing the cause, and by proceeding with artificial respiration as in the case of suffocation from drowning. A line should be made fast to a man before sending him down into an old well or suspicious excavation, or in the presence of irrespirable gases, as are sometimes present in bilges or fuel oil tanks.

The treatment of accidents and emergencies.—*Foreign bodies in the eye* usually lodge on the inner surface of the upper lid. If they cannot be seen on the eyeball, tell the patient to look down, press a match, pencil, or the edge of a finger across the upper lid, half an inch above its edge, at the same time taking hold of the lashes and turning the lid up. Remove the foreign body with the angle of a card or a twist of cotton on the end of a toothpick.

Foreign bodies in the ear, including insects, are best removed by gentle syringing with warm water, or by pouring warm

water into the ear. Objects that swell in water should not be removed in this way. Rough manipulations about the ear are dangerous.

Bites and stings of insects.—Extract the sting if possible; squeeze the part lightly, which will expel some of the poison. Pressure made with the barrel of a hollow key is excellent. Afterward apply a little ammonia water, wet salt, or a slice of onion. Cold, wet applications may, if necessary, be applied afterward.

The stings of poisonous spiders, tarantulas, scorpions, and centipedes often make their victims very ill, but rarely are any of them fatal in their effects.

Cut off the circulation with a string, or tourniquet, and suck the wound strongly until the part is freed of poison, then apply ammonia water and cold, wet applications.

Snake-bites.—The poisonous snakes of North America, except the coral snake, belong to the pit-viper family, which includes rattlesnakes, copperheads, and water-moccasins. These snakes have a pit or depression between the eye and nostril, which readily identifies them. Their heads are heart-shaped, bodies thick, and their teeth are arranged in two rows. Outside the teeth, in the front part of the upper jaw, are two fangs, one on each side. Fangs are characteristic of poisonous snakes everywhere. If the bite shows wounds from two rows of teeth and two fangs it is that of a poisonous snake. A single puncture usually means a fang-prick.

The teeth of the non-poisonous snakes are arranged in four rows, and the bitten part would show four rows of punctures.

Treatment.—If possible, have the snake examined at once. Should it prove to be a non-poisonous snake, then no treatment will be required.

In every case of snake-bite proceed as follows, unless the snake is known to be of a harmless type: Tie a strong ligature or two, a string or handkerchief, between the wound and the

heart, wherever practicable; suck the fang-punctures strongly, first cutting into each, with a pen-knife, a half inch deep and a half inch in length, if possible. Loosen the ligatures for a few seconds at the end of a half hour, and from time to time afterward, to prevent gangrene from stoppage of the circulation. Give alcoholic stimulants in small doses, at frequent intervals, but never to excess.

Amputation and cauterization are not necessary. Strychnine, given with a free hand, is the best medicinal treatment; this should be employed only by a medical officer.

Effects of heat.—Burns are caused by fire or dry heat. Scalds are caused by hot liquid or moist heat.

There are three degrees of burns: First degree, a mere reddening of the skin; second degree, the formation of blisters (these two degrees of burns are not followed by scarring, and, unless one-sixth of the body surface is involved, recovery may be looked for); third degree, charring and destruction of the tissues. Both layers of the skin are burned, and scarring always follows. These injuries are common in the naval service, and are often of extreme gravity.

Shock to the system. This is in direct proportion to the superficial extent of the burn. Stimulants and quiet are the first essentials. If the shock, as shown by a cool, moist skin, shallow breathing, and weak pulse, is severe, it should be treated first, and the local injury afterward, when reaction has set in.

The local injury.—Remove the clothing with the utmost care; see that no blisters are broken. It may be necessary to cut the clothing away, and if parts adhere they may be removed by soaking them in oil; if this is not sufficient, the part should be immersed in a bath of warm water. Only one part should be dressed at a time. In severe and extensive burns a greased bed sheet wrapped about the entire person makes an excellent temporary dressing.

To dress burns, proceed as follows: Apply over the burned parts pieces of lint soaked in a two per cent solution of picric acid in water, or a saturated solution of common washing soda (two heaping tablespoonfuls to a pint of water). Boracic-acid ointment (10 per cent) spread on lint and applied to the burned parts makes a simple and excellent dressing. Strong antiseptics and powders should be avoided, and the dressings should not be changed too often. Normal salt solution—made by dissolving a teaspoonful of common table salt in a pint of water, bringing it to a boil, and then cooling it—is the only solution that should be used in cleansing burns and bathing wounds in general.

Burns from acids.—First flush the parts with water, wash them with a saturated solution of common washing soda, and then treat as for an ordinary burn.

Burns with alkalies.—Flush the parts with water, then wash with a dilute mixture of vinegar and water, one part in four; and finally treat as for an ordinary burn.

To extinguish the flames from burning clothing.—Throw down the person whose clothes are on fire, and cover him up as quickly as possible with a coat, blanket, rug, or anything at hand that will smother the flames. The impulse to escape is irresistible.

Sunburn.—Sunburn should be treated in the same manner as other burns. Lime-water, with the addition of two drops of liquid carbolic acid to the ounce, is a very soothing application.

Heat stroke and heat prostration.—In a body of men exposed to identical conditions of heat of sun and high relative humidity, strange to say, certain cases will exhibit typical heat stroke while others will show evidence of heat prostration.

These two conditions show symptoms which are nearly opposite, and the treatment for each is entirely different.

Heat stroke is characterized by a high temperature; the skin is hot and dry, the face flushed and the eyes bloodshot, and there is often delirium or convulsions. The pulse is full and strong.

The treatment consists of methods to cool the patient off. Ice baths and cold enemas until the temperature is nearly down to normal; never give stimulants.

Heat prostration is characterized by normal or subnormal temperature, the patient's skin is cold and clammy, and the face is pale. The pupils are dilated, the pulse is very weak, and the respirations are shallow.

Treatment: Give stimulants and apply hot water bottles and blankets. Give a hot enema. Discontinue treatment when patient gets warm.

The actinic or ultra-violet rays of the sun can penetrate the skull and will produce an inflammation of the brain with symptoms of heat stroke. This cannot occur with proper head covering.

The effects of the heat of the fire-room on board ship are always shown in the form of heat prostration, and in these cases occurring aboard ship you have in addition to the usual symptoms of that disease ashore, cramps of the muscles of the abdomen and arms and legs.

Alcohol, obesity, overcrowding, muscular fatigue, and insufficient circulation of air predispose to heat stroke and exhaustion. Both these conditions lead to lack of mental concentration or loss of memory with recurring headache upon even moderate exposure to the sun.

Effects of cold.—Frost-bite most often involves the toes; still, the fingers, ears, and nose are frequently frozen.

Treatment.—All forms of frost-bite, or local freezing, are to be treated in the same way, which consists in gradually bringing the temperature up to the normal point and maintaining it there. For this purpose use moderate rubbing, warm

wet cloths, or soak the part in moderately hot water. It is not necessary to rub the part with snow—it is the rubbing that is beneficial, not the snow. Soaking in ice-water is harmful. If the skin peels and sores are formed, dress as an ordinary wound.

Freezing.—If the whole body has long been exposed to extreme cold, there will follow a depression of vitality, which requires most cautious treatment.

Treatment.—Restore bodily warmth by surrounding the patient with heated blankets, or by exposing him before an open fire. It is safe to bring him into a moderately warm room. If a bath can be given, immerse the patient in warm water, and gradually increase the temperature until it is as hot as can be borne.

Stimulants, such as hot tea or coffee, in moderate quantity, may be given internally, with the addition of small quantities of spirits.

Shock by electricity.—Persons taking hold of naked live wires, with a current of high tension passing through them, would be violently convulsed and be unable to let go, or there might be insensibility with suspended animation, or even death. Parts of the body or clothes in contact with the wires may be scorched or burned.

Treatment.—Promptly remove the sufferer from the source of the danger. This must be done with the greatest care, otherwise the person giving the assistance may be dangerously shocked. The rescuer's hands should be protected with rubber gloves; if these cannot be procured, first wrap a mackintosh coat, or a thick, dry woolen-cloth coat, or other dry article of clothing, around the patient, and then pull him away from the source of danger. Two live wires in contact with the patient may be short-circuited by dropping an iron bar, or a metallic tool, across them.

The patient should be laid in a quiet place, his clothing

should be loosened, and he should have plenty of fresh air. Medicines are not required. If breathing is suspended or feeble, artificial respiration should be resorted to immediately. The mouth will not have to be cleared as in drowning accidents, but care must be taken that the tongue does not fall back so that its base will close the breathing passages.

Lightning stroke is much the same as electricity in its effects, and the treatment is the same.

Unconsciousness or insensibility.—Unconsciousness may be due to disease of the brain, to disease of the heart, to general diseases, to injuries of the head, and to poisons of various sorts.

Treatment of unconsciousness.—The treatment suitable for all cases is to secure quiet and rest, the body being laid upon the back, with the head a little raised. If there is great paleness and a cold surface, with slow, sighing breathing (signs of prostration), smelling-salts, or a few drops of ammonia on a cloth may be held under the nose while heat is applied to the body. If there is great heat of the surface, cold may be applied to the head and body. If the patient is fully unconscious, drinks should not be administered, as the fluid is apt to get into the windpipe, which would cause the patient to strangle.

Fainting.—A fainting person should be laid out flat at once. The head should be as low as or lower than the body, in order to get blood to the brain. Tight clothing should be loosened. Ammonia held under the nose will sometimes act promptly. After a fainting fit, give half a teaspoonful of aromatic spirits of ammonia in a tablespoonful of water. A little alcoholic stimulant in hot water may be useful. It is dangerous to keep a fainting person in an upright position.

In a crowded room, fainting may be prevented by placing the patient in a stooping position, with his head between his knees and at a lower level than his hips. This will usually ward off an attack, but this plan must not be employed if the patient has fainted completely.

Epileptic fits.—The patient falls with a cry, his face is livid, he has convulsions, and foams at the mouth. His tongue and lips are often bitten.

Treatment.—Gently lay the patient on his back and control only those movements calculated to injure him; do not struggle against such movements as will do no injury. To prevent the lips and tongue from being bitten, put a folded towel or a bit of soft wood, or a cork with a string attached, between the teeth. The fit usually lasts but a few moments, after which the patient falls into a deep sleep, and should not be disturbed.

The treatment of poisoning by unknown poisons and poisonous foods.—If treated promptly cases of accidental poisoning are rarely fatal. Proceed as follows: If possible, give a large quantity of lukewarm water and tickle the back of the throat with a finger or a feather. A tablespoonful of common powdered mustard in a tumbler of warm water is an excellent emetic. Two tablespoonfuls of common table salt in a tumbler of warm water is also an excellent emetic. These emetics may be repeated once or twice. Soapsuds or dish-water may be drunk. Soap is an antidote for many poisons. The patient must be forced to drink a large quantity of fluid, and be made to vomit several times, though not pushing this to exhaustion. After copious vomiting, soothing liquids should be given, such as oil, milk, beaten-up raw eggs, or flour and water—each in moderate quantities. These are valuable when the poison has been of an irritating character.

If the patient is in collapse, give stimulants such as hot tea, without milk, as it is a chemical antidote for many poisons. Coffee is next in value. Alcoholic stimulants in teaspoonful doses in hot water should be given as well. The patient should be covered with warm blankets; and hot bottles, or hot bricks, properly protected, should be applied next to his body.

Acid poisoning.—In acid poisoning, give alkalies, such as a tablespoonful of aromatic spirits of ammonia in two teacupfuls of water, or baking soda, whitewash, chalk, tooth-powder, whiting, plaster from the wall, or soap.

Alkaline poisoning.—In alkaline poisoning, vinegar can generally be had, and there is nothing better. It should be given undiluted and freely—a half teacupful at a time. Lemon juice may be used.

After the antidote has been given in cases of poisoning either by acid or alkalies, milk, oil, or beaten eggs should be administered and rest should be secured.

Wood alcohol poisoning.—Wood alcohol, which is one of the most dangerous poisons known, has caused many deaths in the naval service, and has induced total and permanent blindness in many of those who have escaped death. The men should be taught that the penalty for drinking wood alcohol may be permanent total blindness or death. Wood alcohol receptacles should be labelled so that the danger will be made known to those likely to drink of their contents, and the alcohol should be made undrinkable by the addition of a small percentage of naphthalin.

The symptoms are great abdominal distress, vomiting, pronounced depression, unconsciousness, and death. If recovery does occur, blindness is likely to follow in a few hours.

Treatment.—The treatment should be the same as that given for poisons in general. Stomach and rectum should be washed out immediately.

In all cases of poisoning, the patient should be urged to pass urine.

In all cases where it is known that poisons of any kind have been swallowed, if a stomach tube is at hand and there is any one present who knows anything about its use, the stomach should be washed out thoroughly, filling and emptying it several times with water, about one quart each time.

A warm enema should be given as soon as you are finished with the cleansing of the stomach. The enema should consist of about two or three quarts of warm water given slowly, and after being expelled, can be repeated with benefit.

Sprains.—A sprain is a straining or tearing, by a sudden twist or wrench, of the ligaments and capsule which surround a joint.

Signs.—Pain, heat, and swelling at seat of injury, followed by discoloration of the skin. The ankle, knee, and elbow are the joints most commonly sprained. The bones about the wrist joint are very commonly broken, but the joints are rarely sprained.

Treatment.—Put the parts at complete rest and apply cold. If the pain is severe and cold applications cannot be tolerated, bathe the joint with water as hot as can be borne comfortably, or apply hot flaxseed poultices. A snug bandage should be applied afterward. Later on the joint should be strapped with rubber plaster. Massage should be employed in many cases. When a sprain involves a joint of the upper extremity, the forearm should be supported by a sling after the joint has been treated. A light padded splint should be applied behind the knee, when that joint is injured; the patient should use crutches, if he moves about at all, in cases of sprains of the ankle and knee joints.

The patient's care of himself.—Follow directions faithfully. Too early use of a sprained joint induces weakness of that joint and a tendency to a recurrence of the sprain.

An injured joint should be kept slightly elevated by placing it on a pillow or other support.

Dislocations.—A dislocation is the displacement of the end of a bone which enters into the formation of a joint. Dislocated bones usually lie away from the body, and cannot be brought to the side so as to parallel the long axis of the body. There is distortion of the joint; the end of the bone can be

felt under the skin, and by comparing with the uninjured side, it will be recognized as out of its normal position. There is pain on attempting to move the bone, and loss of motion in the joint.

Treatment.—The risk of doing injury by injudicious efforts to replace a dislocated bone is greater than that of delaying until the services of a medical officer can be had. The best that can be done is to put the parts in the position easiest to the patient, and to surround the joint with cool, wet cloths, or with cotton and a bandage.

The patient's care of himself.—He should keep as quiet as possible until the dislocated bone has been replaced, and should steady the injured part by taking hold of it. He should lie down if the injury has made him feel faint.

Fractures.—A fracture is a broken bone. A bone may be broken by direct violence, as a blow with a stick or by a bullet; by indirect violence, as a fall on the outstretched hand with fracture of the collar-bone. A bone may also be broken by intense muscular contraction.

Signs of fracture are pain, swelling, and deformity, with loss of muscular power. The pain and swelling are due to the injury to the parts, and the deformity is due to the displacement of the pieces into which the bone was fractured. The pieces may be placed at right angles to each other when normally they form a straight line: as in a fracture of the middle of the arm you could have, between the shoulder and elbow, an angular deformity, and with motion at this point between the broken ends, you would have a joint in the middle of the arm; this latter is called unnatural mobility, and is also one of the signs of fracture. In handling a fractured part, the ends of the bones grate together; this grating can be felt through the skin, and is one of the signs of fracture.

There are two general varieties of fracture, simple and compound.

Simple fractures are those which are beneath the unbroken skin.

Compound fractures are those in which an external wound, communicating with the break, exists.

Treatment.—In the immediate treatment of a fracture, the following points should be attended to: (1) the prevention of further injury, and (2) the preparation of the patient for transportation.

To prevent further injury: Attend to the patient on the spot where the injury occurred, especially if the fracture happens to be in the lower extremity.

Do not touch the limb (beyond what is necessary for diagnosis) until you have splints and bandages ready.

Handle the injured part with extreme gentleness. By rough handling a simple fracture may be converted into a compound or complicated one, especially where the bones are immediately under the skin, like the collar-bone and the shin-bone.

Without removing the clothes (unless the fracture is compound or there is hemorrhage), bring the bones into their relative positions as follows: First lift the limb by grasping it gently but firmly above and below the seat of fracture, and then make gentle extension and counter-extension, in the normal line of the bone, which should cause little or no pain if done properly. Fix the limb in this position by means of splints and bandages.

Splints are more or less rigid supports used to immobilize joints and fractured bones. Many articles in daily use, and others that can be found in the field, can be used to keep the injured parts in place. For instance, broom-handles, newspapers, wine-bottle covers, stockings filled with straw or sand, pieces of wood and laths can be employed. In the field we may make use of the branches of trees, pieces of bark, shrubs, rifles, and bayonets. The opposite leg can be used as a splint

for the injured one, and in the case of the upper extremity, it can be splinted against the chest by snugly binding it there with bandages.

Improvised splints.—These splints should always be constructed out of material which is sufficiently stiff to keep the parts in position; they should be made long enough to extend some distance beyond the joint below the point of fracture, and beyond the joint above it, if possible. They should be as wide as the limb to which they are applied. Before applying splints, pad them well on the side next to the limb (unless the clothing is allowed to remain on) with some soft material, such as towels, cotton, wool, oakum, straw, flannel, folded triangular bandages, etc., and make the padding extend well over on each side of the splint.

To apply splints.—Two persons are required: one makes traction and gently lifts the injured part while pulling steadily in the line of the injured bone. This can sometimes be done with one hand. In that case the other hand should be put under the seat of fracture to support it. The second person applies the splints, one on each side of the limb, and fixes them in position by tying about them, above and below the line of fracture, triangular bandages, folded narrow, or straps, belts, suspenders, tapes, or rubber plaster. All knots should be tied over the outer splint, and not over the bone. The general rule that injured parts should be elevated holds good in the case of fracture. The splint should not be applied so tightly as to impede the circulation. If splinted limbs are allowed to hang down, swelling follows, and the circulation may be dangerously cut off.

Treatment of compound fracture.—First treat the wound, then set the fractured part in the normal position and secure it there by splints.

If bleeding is profuse, a tourniquet may be applied for a short time, one hour or less. The wound should be dressed

at once to protect from infection. An infected compound fracture is very hard to treat. There will be no union of the broken bones until the wound is made clean by frequent washings with sterile solutions, and free drainage must be kept up so that the pus and infected material can be freely discharged.

After the wound becomes clean and healthy looking and begins to heal, more attention can be paid to keeping the parts in the correct position; of course, all handling must be very gentle.

Transportation.—As a rule, persons with broken bones should not be removed until the bones have been splinted. Faintness is apt to come on after a fracture, but usually persons suffering from fractures of the upper extremity can walk with assistance. Those suffering from fractures of the lower extremity should be carried on a stretcher.

The injured person's care of himself.—Should the patient believe he has sustained a fracture, he should lie down carefully, and try to place the broken bone in its proper position, which will be found to be the most comfortable one. Under no circumstances should he attempt to walk if a lower extremity has been injured, as, in this way, a simple fracture might be made compound, or the bone ends might be made to tear into a large blood vessel.

Special fractures.—Fractures of the skull should be immediately covered with a sterile dressing and the patient should be kept as quiet as possible until the services of a surgeon can be obtained.

Fracture of the jaw.—Tie a triangular bandage or a handkerchief under the chin and over the top of the head.

Fracture of the ribs.—Pass a wide band of rubber plaster, or several bands, two-thirds around the chest, while the arms are held over the head and the chest is emptied of air; or snugly apply wide bandages.

Fracture of the collar-bone.—Apply a sling; the idea being to support the weight of the upper extremity on the injured side, which is normally borne by the collar-bone.

Fracture of the arm and forearm should be treated by gently forcing the parts into their normal position and then applying splints to hold them that way.

Fracture of the leg.—An ordinary pillow tied about a broken leg makes an excellent splint; boards can be placed outside the pillow to make it more rigid.

Fractures of the thigh are very difficult to treat, as the muscles contract and cause the fractured ends to overlap each other. Of course union in this overlapping position will cause shortening of the limb.

Strong extension has to be made to get the ends of the bone opposite each other, and it has to be kept up all through the three to six weeks of treatment in order to keep them in that position. For temporary treatment, a splint should be applied which extends from the armpit to below the sole of the foot. The feet should be tied together, also the legs below the knee.

Wounds.—A wound is an opening through the skin with destruction of tissue. Wounds may be incised, produced by a cutting instrument and having clean-cut edges; or they may be lacerated, with ragged edges, as caused by machinery or a bursting shell; or they may be punctured, as with a pointed instrument.

Wounds are either clean or infected. The former can only occur where the instrument producing the wound is clean and no dirt is carried into the wound at the time of the injury; and it will remain clean only so long as it is covered with a clean dressing. It takes expert knowledge and skill to be able to handle a clean wound without getting it infected, so that if there is reason to believe that a wound is not infected a clean dressing should be applied as quickly as possible; and

the wound, having been thus protected from the entrance of germs, should be left alone. At the end of one to four days, without removing the dressing, it is possible to tell whether a mistake has been made in believing a wound not infected. The symptoms which show that a wound is infected are pain and swelling in the region of the wound, and fever. Of course, in a large wound, even if not infected, there will be a certain amount of pain and soreness with some swelling, and there will be slight fever, but any marked rise in temperature with pain in injured part would indicate infection, and the dressings would have to be removed and the wound treated as an infected one.

Infected wounds are wounds to which germs or bacteria have gained access. These germs are present everywhere, sometimes one species and sometimes another, and often several different species. When not living as parasites in the body they live in all kinds of organic matter (filth), on the surface of the skin, on clothing, in the ground, and in the thin film of dirt which covers the surface of most objects. They may be carried in organic matter in the form of dust particles, and thus settle on and infect wounds. Hence all wounds, whether clean or infected, should be immediately covered by a protective dressing; when clean, to prevent infection, and when infected, to prevent further infection.

A wound may be infected with any one of a dozen or more species of bacteria having varying degrees of virulence, and each producing its own particular train of symptoms; or a wound may be infected with several different species of bacteria, all acting at the same time and thus increasing the gravity of the case.

Some of the most important germs which infect wounds are as follows, given in order of their virulence:

The tetanus bacillus occurs in the ground; most often in rich cultivated soil. It will not grow in the presence of air (is anaerobic), therefore surface wounds are not likely to

become infected by it, but deep punctured wounds with rusty nails or pointed objects which have been in contact with the ground will carry these germs into the depth of the tissues, where they are excluded from the air and can grow. These germs produce a toxin which is the most poisonous substance known; 1/500 of a grain of it will produce death. It is the germ which causes lockjaw, and an infection with it is almost always fatal.

The symptoms commence about five or six days after the punctured wound. They are spasms of the muscles, with high fever and delirium. The muscles of the jaw are so tightly contracted that the teeth are locked together. Little can be done toward a cure after this disease has once started, but the immediate administration of a serum called anti-tetanic serum in all cases of punctured or gunshot wounds where there is a chance of infected soil being carried into the tissues will very often prevent the development of this disease.

The bacillus perfringens, or gas bacillus, is another extremely virulent germ which occurs in the soil. It enters the system through punctured or mutilated wounds, and often proves rapidly fatal. It produces gas while growing in the tissues, so that the parts around the wound are filled with gas bubbles and the pus which runs from the wound is foamy. It produces death of the tissues in the region of the wound, which have a dark brown color. The pus is a red-brown color.

The gas bacilli spread from the wound into the blood and are carried all over the body, producing a condition called septicemia, which is commonly called blood poisoning, and is very fatal.

The Streptococcus pyogenes is a delicate germ which does not live long outside the body; it is an obligate parasite, but can remain alive long enough in pus discharges to be transferred from one wound to another by hands which, having

come in contact with pus-covered objects, later dress a non-infected wound.

This germ produces a thick, yellow, creamy pus at the site of the wound, and produces high fever. It is very likely to enter the circulation, producing blood poison.

The Staphylococcus albus is a germ which lives in the healthy normal skin, and only attacks the tissues when they become weakened by injury, or it will attack the skin where the circulation is poor, causing boils; it causes a yellow pus, and is a mild form of infection.

There are many other species of germs which will enter and grow in a wound, producing local death of the tissues and more or less grave general symptoms; and volumes could be written on the many phases of their existence, and the various symptoms they produce.

For practical purposes we consider all objects infected which have not been sterilized, and we allow only sterilized objects to come in contact with a wound, whether the wound be infected itself or not.

By sterilizing everything, we mean the hands of the attendant, or whoever does the dressings; the wound, and region of the wound if it is infected. If the wound is not infected it must be touched as little as possible or not at all, to avoid all chance of infecting it. Most fresh wounds must be regarded as clean, as there is little to gain by cleaning them unless the dirt particles are plainly visible. A clean cut of the hand, even where the hand is covered with dirt, will often heal much more quickly, if simply covered with a clean dressing and left alone, than one which is washed out carefully and then dressed.

The reason for this is: in washing a wound you are almost sure to carry some of the dirt from the surrounding skin into it; whereas, when the wound is not washed, the constant flow of blood and serum outward tends not only to prevent entrance of dirt, but to carry it out of the wound.

It is best to dress all wounds by just pulling away the loose clothing without any cleansing with any kind of liquid, then applying a little tincture of iodine and covering with a sterile piece of cloth. Two or three days later, if no symptoms of pain, swelling, or fever develop, you may feel confident the wound will heal rapidly with no complications; but if symptoms do develop, you know the wound is infected, and you must remove the dressings and treat as an infected wound. An infected wound must be washed out with sterile water or an antiseptic once or twice daily and redressed with clean sterile gauze each time.

All water used for washing a wound or the skin surrounding a wound must be previously sterilized by boiling for one-half hour and then allowing to cool in the same containers in which it was boiled.

All dressings must be sterilized by boiling if not taken from sealed containers in which they have been previously sterilized after sealing.

Before dressing a wound the hands should be washed in soap and water, using a nail brush to scrub them with; then they are washed in an antiseptic solution.

Solutions which may be used to sterilize the hands after first scrubbing with soap and water:

Bichloride of mercury in water......	1 to 2000
Alcohol	70 per cent
Carbolic acid	1 per cent in water
Chlorinated lime, tablespoonful to the quart	

Solutions which way be used to wash out wounds and skin around wounds:

Bichloride of mercury in water......	1 to 4000
Carbolic acid in water...............	1 to 500
Dr. Dakin's Fluid:	
Sodium carbonate	140 grams
Chlorid of lime................	200 grams
Boric acid	40 grams
Water	10 liters
Boric acid solution.	

Boric acid solution made by dissolving as much boric acid as will dissolve in hot water.

The last two solutions are good germ destroyers and can be used *ad libitum* on wounds on any part of the body.

Ordinary cloths, pieces of undershirts, or any absorbent material can be used for dressing a wound after being boiled.

Boil dressings in solution of boric acid or common salt in water in a basin, and allow to cool. Next wash hands and disinfect them, then pour sterile solution in which dressings were boiled over wound to wash it out, then apply sterile dressing, wet. In this way a wound can be washed out with sterile water and a sterile dressing applied, by simply boiling a piece of undershirt in a tin cup; and for all practical purposes it will serve just as well as sterile solutions in fancy bottles, and elaborate dressings.

Treat all wounds as aseptic wounds (that is, clean wounds) until you feel sure they are infected. Then treat them as infected wounds. The former, as before stated, require covering up with a sterile dressing and then leaving alone until entirely healed, unless the symptoms of pain, swelling, and fever develop at the end of two to seven days. The pain and swelling which occur during the first twenty-four hours after a wound cannot be due to infection, as it is impossible for the symptoms of infection to develop so quickly. Infected wounds must be treated by allowing to remain open in order to facilitate free discharge of pus, dressed with sterile wet dressings to absorb discharges, and dressed at least once a day to keep discharges from accumulating under the dressings.

Wounds in detail.—A clean-cut wound produced by an instrument with a sharp edge, as a knife, is called an incised wound. When clean, all that is necessary in the way of treatment is to bring the edges of the wound together and hold in that position by stitches, adhesive plaster, or bandage, and keep covered with a sterile dressing.

An ordinary needle and cotton thread can be boiled at the same time as the dressings and will do to sew up a wound.

If a blood vessel in the wound is spurting in quantity, it can be stopped by applying a tourniquet above the wound and then passing a stitch under the bleeding vessel, the two ends of which can be brought up over the artery and tied. The end of the spurting artery can be taken hold of by a pair of tweezers (dressing forceps, they are called) by one person, and another person can pass an ordinary piece of string around the artery an eighth to a quarter inch from its cut end; this should be drawn tight and tied with a square knot. Where a wound is sewed the stitches should be removed in seven or eight days.

A lacerated wound is one in which the tissues are torn; pieces of clothing are likely to be carried into the wound, and infection is often present. With a pair of dressing forceps which have been sterilized by boiling, foreign matter should be removed from wound; and with sterile scissors pieces of tissue which are only hanging by a thread should be cut away. Tincture of iodine should be spread over the wound, and a sterile dressing applied.

A contused wound is one caused by a blunt instrument, and there is considerable bruising around the wound, which diminishes the vitality of the tissues and causes them to be more susceptible to infection. Treat as for lacerated wound.

Punctured wounds are wounds caused by a sharp-pointed instrument, as a nail, and are particularly hard to treat, as infected material is likely to be carried deep into the tissues. The skin often heals over while the bottom of the wound is developing pus. Every wound of this kind should have a drain in the form of a sterile piece of string or gauze passed down to nearly the bottom, and this should be kept in five or six days, or until pus stops discharging if the wound is infected. Where it is known that the wound was caused by

an instrument which has been in contact with the ground, the wound should be enlarged with a penknife or surgical knife, if at hand, and washed out with boiled water, followed by the free use of iodine, peroxide of hydrogen, or 1 to 1000 bichloride. This precaution is to prevent lockjaw. Antitetanic serum should be administered at once. Gunshot wounds frequently become infected by the tetanus bacillus.

Treatment of wounds aboard ship.—These will be due to accidents in connection with the running of machinery, bursting shells, and flying pieces of metal or other material set in motion by the impact or bursting of large projectiles.

These wounds will almost all be of the lacerated and contused variety, and will cover extensive areas. They do not become infected so easily as wounds ashore, and therefore should be treated as clean wounds from the start, with perhaps the added precaution of covering with a little tincture of iodine before covering with the sterile dressing. A clean ship with clean personnel means much toward the prevention of infection of wounds. Before a battle have the whole crew bathe and put on clean underclothing. The Japanese did this in the Russian-Japanese War.

On board ship, during a battle, it is impossible to get more than temporary treatment until the engagement is over, as all the water-tight doors are closed and hatches battened down, and it is impossible for any one to get from one part of the ship to another; the wounded cannot be carried to the surgeon, and the surgeon cannot get to the wounded. First-aid outfits are placed convenient to each gun crew. They consist of large sterile pads of gauze with bandage attached, tourniquets, and sand bags.

When a man is wounded a tourniquet is applied if there is bleeding, the wound is covered with a pad of sterile gauze held in place by the attached bandage, and he is laid on the deck with sand bags on each side of the injured part to keep

it steady. During a lull in battle the stretcher bearers go around and gather up the wounded and take them below, where the surgeon gives them attention.

Application of the first-aid dressing to a gunshot wound.— The immediate treatment of wounds in general is extremely simple. As a rule, if the wounded part is freed of constricting clothing between the heart and the wound, and is elevated, or held up, bleeding soon ceases. Of course, whenever it is possible to secure the services of a medical officer all wounds should be promptly referred to him for treatment, as important nerves, tendons, and other structures might be damaged, thus seriously crippling the part afterwards.

If a wound is kept free from infection, which means poisoning by germs, it will, as a rule, heal promptly, painlessly, and with little scarring. The common sources of infection are the skin of the hands, the skin about the wound, the hair, soiled dressings, and foreign bodies, like bits of clothing carried into the wound.

The immediate treatment of gunshot wounds differs in some particulars from the treatment of wounds in general.

Under no circumstances attempt to disinfect or wash the wound.

The wound is not to be touched with the fingers. Avoid handling that part of the dressing which will come in contact with the wound. The danger of infection from unclean fingers is very great, and is more serious in its effect, as a rule, than the destructive action of the bullet.

The dressing should be applied to the wound without cleansing it, but just as it is found; and great care must be taken to see that the compresses do not slip to one side and expose the wound to germ poisoning.

In dressing wounds of the hairy scalp, part the hair, without touching the wound, before applying the compress.

If the injured part can be readily exposed, it should be done.

If the contrary is the case, then the clothing should be slit up with a knife.

The majority of these wounds heal under a single dressing. The men should be made to understand this, as they are usually impatient to have their wounds dressed frequently.

Under no circumstances are dried blood-crusts and scabs to be disturbed.

Wounds ashore.—In modern warfare, disease and deaths from disease are decreasing, while wounds, injuries, and deaths from violence are increasing. The character of wounds received in battle both on land and at sea has greatly changed in the past thirty years, and the increasing amount of machinery coming into use both ashore and afloat has increased the number of injuries many fold. Certain conditions and factors during the present war in Europe[1] have led to relegating the rifle to a comparatively insignificant place in the art of maiming or crippling the activity of large groups of men.

The close contact of well-constructed and protected opposing trenches, the development of the hand grenade, bomb, high explosive shell, shrapnel, machine gun, and asphyxiating gas have all combined to greatly limit the usefulness of the rifle, in the eyes of the modern military man. There is no doubt of its usefulness, however, in the hands of an alert sharpshooter when a target presents itself, either in trench work or in "sniping"; its moral effect is not to be overlooked.

As a most valuable and inseparable adjunct to the rifle, after the artillery has prepared the way by breaking up the barbed wire and other obstructions, the use of the bayonet in carrying a position has been a weighty factor during the operations of the present war.

The modern rifle bullet has a very high velocity, long range, and deep penetration. Its effects on the tissues of the body are

[1] Quotations from Surgeon A. M. Fauntleroy's report on the medico-military aspects of the European War are freely made in this section.

varied, depending upon the part or parts struck, the range, and whether the bullet has been deformed by ricocheting.

At all ranges it penetrates soft, spongy tissue, making a clean perforation, somewhat larger at the wound of exit.

Solid organs, as brain, liver, etc., are penetrated with a clean perforation at mid-ranges, 500 to 1200 yards, but at close ranges, under 500 yards, the bullet has an explosive effect, causing bruising and complete destruction of all tissues in the vicinity, and a large wound at exit.

A bullet entering one side of head at close range will sometimes carry away the whole of the opposite side. At long ranges, when the bullet begins to wobble or tumble, it will cause very large and destructive wounds.

The effect of the high-power rifle bullet on bones is very destructive at all ranges; under 500 yards there is always an extensive shattering, with the driving of splinters into the adjacent tissues, with consequent destruction of blood vessels.

The offensive by sapping has brought the Allies and German lines in the present trench warfare into very close contact. In come cases the trenches are five or ten yards apart.

The depth of the trenches and the protection they afford are such as to render rifle fire of very little value in storming the occupants. Since the trenches are so close together in the first line that neither side can use artillery freely without greatly endangering their own troops, grenades have assumed a very important rôle in this character of fighting, and so much so that at present, under certain circumstances, they are the principal means of putting a section of trenches out of action.

The grenade wounds, besides the usual great destructive effects, are always infected wounds, the fragmented casing carrying into the tissues particles of clothing and dirt, and resembling in this and other respects the shrapnel and shell wounds.

The artillery used by the opposing forces, with the exception of the light field pieces, has been undergoing various changes since the war began, to suit the varying conditions along the entire front.

On account of the barbed wire entanglements and other obstructions used in the present trench warfare, it has been found necessary by both sides to employ an increasing number of high explosive shells, which are usually used in siege operations to clear the way in advance of assaulting troops.

The high explosive shell gives rise to small as well as large fragments, and there are usually multiple wounds from the same shell.

Shrapnel shells are used to explode over trenches, and their wounds are characterized usually by considerable contusion and destruction of deep tissue as the result of the "mushrooming effect" of the soft, unjacketed lead bullet, especially when compact bone is struck.

Shell and shrapnel wounds are practically always infected, on account not only of the large, gaping wound, but also on account of the pieces of clothing and dirt driven into the tissues by the missile.

Death from these shells without any apparent wounds takes place, and may be due to the blow the body receives from the primary violent air-impact delivered as a blow over one side of the body. Men are sometimes hurled into the air as a result of the explosion.

Asphyxiating gases, such as chlorin, or bromin, carried in liquid form, are liberated from metal tanks when the wind is blowing toward an opposing trench. Being heavy gases, they hug the ground, moving to leeward, and sink into the trenches. The first effect is to cause the eyes to water, and this is quickly followed by a violent irritation of the bronchial tract. If the troops are unprotected and remain in the trenches, they rapidly develop a capillary bronchitis with

hypersection of a thin, watery mucus which fills up the air spaces of the lungs and practically causes death from drowning. Those receiving concentrated doses have died in from one to three hours. The mortality from this form of suffocation depends on the degree of concentration of the gas inhaled, length of time exposed, and the age of the patient.

Prevention of this form of suffocation is accomplished by a respirator, which is a mask-like arrangement that covers the whole face. There are eye-holes covered with a transparent material to protect the eyes, and a perforation for breathing. The opening for breathing is so arranged that a piece of cloth saturated in a solution of a chemical which absorbs chlorin or bromin can be placed just inside in front of the nose and mouth. The air breathed passes through this cloth, and the chemical with which it is impregnated, equal parts hyposulphite and carbonate of sodium, absorbs the noxious gas.

As regards treatment, those in the open air seem to suffer less. Oxygen gas administered slowly unquestionably gives relief. Lateral prone position favors drainage of the lung fluid.

Flame projectors are used by the Germans for throwing burning liquid. They are much like the ordinary portable fire extinguisher in construction, throwing a liquid which at once catches on fire spontaneously and has an effective range of thirty yards.

The burns caused by this method are of the deep, sloughing variety, exposing tendons and bones, and are treated with wet dressings until healthy granulations appear.

These flame projectors are employed in street and house-to-house fighting.

Under the present circumstances of the trench warfare in Europe, it would seem well-nigh impossible to obviate an exceedingly high percentage of wound infection, and especially infection with the organism responsible for progressive emphy-

sematous necrosis and tetanus. The reasons for this are not far to find. In the first place, the entire Western European war area has undergone for many years an intensive process of cultivation, which has resulted in the soil being saturated with fertilizers and caused it to be the medium *par excellence* for harboring these infective organisms. Once the trenches are dug deep in this soil, there is no escape from the ever-present conditions which are favorable for infecting every wound. Soldiers are obliged to occupy these trenches for days and nights consecutively under all weather conditions, so that their clothing and body surface become more or less permeated with the trench dust and dirt, which of course contains the infective organisms in great numbers.

The tetanus germ is the germ of lockjaw, and occurs in most manure. It may be found in any rich soil.

The germ of progressive emphysematous necrosis is called the bacillus perfringens, or Welche's bacillus, or the gas bacillus. It occurs in the same kind of soil that harbors tetanus bacillus, and is anaerobic like that organism. When a wound is infected by this organism, you have at first a necrosis or death of the tissue in the region of wound; then after a few hours the production of gas in the tissues is noticed, then a general septicemia and death.

Methods to prevent the infection of wounds by the dirt of the trenches divide themselves into cleanliness of trenches and person, and the antiseptic instead of the aseptic method of first-aid.

Trenches should be thoroughly policed and whitewashed, and some kind of flooring improvised. Men should bathe and change their underclothing as frequently as possible.

As before stated, rifle-bullet wounds make up a small percentage of injuries in the present war. Most of the wounds received are caused by shell, shrapnel, and grenades, and they are of the large variety with extensive destruction of tissue,

leaving large areas of surface uncovered by skin. Pieces of clothing and fragments of shell are carried into the wound, so that it is quite impossible to have a wound of this kind without some grade of infection.

The simple application of a sterile first-aid packet dressing will not prevent infection. It will protect from further dirt getting into the wound, and is undoubtedly useful as a temporary covering until the wounded man can be gotten to the nearest first-aid station; but these dressings should be removed within a few hours, and the wound carefully but gently cleaned and antiseptically treated. First-aid packets like ours are carried by all soldiers, and, in addition, a small bottle of iodine, which is poured into the wound before the first-aid is applied.

A wound should be immediately treated by iodine and first-aid dressing, and at the earliest opportunity the man should be removed to a dressing station, where this first-aid is taken off, pieces of shell, clothing, and dead tissue removed from the wound, and the wound washed out with an antiseptic solution. The antiseptic solution found to be the most effective and extensively used by the Allies is as follows:

Dr. Dakin's: 140 grams sodium carbonate, 200 grams chlorid of lime, and 10 liters of water; to this add 40 grams of boric acid. This solution is strongly antiseptic and non-irritating. The wound must be thoroughly washed out with it and a dressing wet with it applied. Continuous or frequent irrigation with this fluid is recommended.

On account of tetanus, all wounded receive as soon as possible an injection of anti-tetanus serum.

Perforating wounds of the abdomen and skull, or injury to blood vessels or vital organs, if not immediately fatal, have a small chance for recovery if treated at once. This means quick removal to a nearby field hospital; and it is not always possible to have a nearby hospital.

Where prompt removal cannot be accomplished, the stoppage of hemorrhage and application of first-aid dressing will be all that can be done. The man should be placed in a quiet, protected spot and made as warm and comfortable as possible. If the wound is a perforating one of abdomen, he should be kept in a semi-sitting posture in order to facilitate drainage into the pelvis.

By far the largest percentage of serious wounds which recover are compound fractures involving long bones, and mutilating wounds of the face. These are among the only cases which bear transportation to the rear, and consequently make up the large percentage of patients in the base hospitals.

The evacuation and care of the sick and wounded has always constituted a problem of the gravest import in every campaign of history. The task, even at its best, is a complicated one; and there is no other class of military work which undergoes such unexpected and startling variations.

As is well known, the three different phases in the movement of a division or an army are that it may advance, it may retreat, or it may remain stationary. Any one of these operations is capable of all sorts of variations along the front, and may suddenly create situations of the greatest difficulty for any one or many of the sanitary or medical department units. If the army advances the wounded become each moment farther removed from the enemy, and there is no serious difficulty in following up and evacuating the wounded to the rear. When an army retreats, however, the difficulties multiply. When an army remains stationary, as in the case of the present trench warfare, the situation is most favorable for efficient work in both sanitary and surgical branches of the medical department.

Food and water can be properly controlled, and systematic policing of trenches and camps carried out. In the present war long marches have not been a feature; consequently the appearance of foot trouble has not been noticed.

In surgical work great advances have been made in the way of portable field hospitals. Complete equipments are carried on groups of automobiles.

The principal observations in the present war in regard to wounds have demonstrated that shell, shrapnel, and grenades produce the large percentage of wounds; that these wounds are large, open ones, with extensive bruising and devitalizing of the surrounding tissue; that particles of shell and infected clothing are almost always driven into the wound, and that nearly all wounds are infected from the start and must be treated as such.

The first-aid packet, as used by the U. S. army, with a small ampule of iodine, should be carried by each man and be immediately used in case of a wound.

The wounded should be removed to first-aid stations as soon as possible for redressing and thorough disinfection after removal of foreign particles of clothing, etc.

Mobile ambulance surgical hospitals are of wonderful value in saving cases which could not stand transportation to the base hospital.

Great care should be taken in regard to personal cleanliness and policing of trenches.

Transportation of sick and wounded.—First-aid dressings having been applied and broken bones splinted, those who have anything to do with moving the patient should kneel on one knee beside him, all on the same side. Next put all hands under the patient, one under head, one under chest, one under abdomen, one under hips, one under thigh, and one under legs. Hands should be placed so as to distribute the weight evenly to each bearer. Two men can lift an average man; and three can handle a patient with great ease; with more than four they get in each other's way. All being in a kneeling position on the same side of patient, with hands distributed

under him, lift him about a foot or two, draw him inward toward the body so that he rests on the knee. At this point a stretcher can be put in the position which the patient occupied before lifting, and he can then be lowered on it; or the bearers can rise from the kneeling position and carry the patient to the stretcher, first kneeling beside it and then placing the patient on it.

The stretchers in common use are the army litter and the Stokes splint stretcher; but should one of these be not available, an improvised stretcher can be made from whatever is at hand.

Among the articles that may be employed as stretchers are boards, window-shutters, doors, bed-frames, mattresses, benches, tables, chairs, blankets, rugs, hammocks, etc.

Rifles or poles may be passed through openings made in the bottom of sacks or coats, or trousers may be used. The rifles or poles can be prevented from spreading too far apart by a turn of rope or telegraph wire.

The rifle stretcher.—Spread a blanket on the ground, lay two rifles (magazines empty) across the middle of it, parallel to each other, and about twenty inches apart, both muzzles pointing in the same direction, trigger-guards outward. Turn a fold of the blanket six inches wide over the ends of the butts, fold the right side of the blanket over the rifle on that side as far as the rifle on the opposite side, then, similarly, fold the left side. These folds of blankets form the body of the stretcher, the butts forming the head.

The pole-and-blanket stretcher.—Place two poles longitudinally along the edges of a blanket and roll the sides of the blanket snugly over the poles until they are twenty inches apart. The blankets can then be tied to the poles, and sticks of wood can be placed between the poles at each end to act as spreaders.

The pole-and-rope stretcher.—Place two poles twenty inches apart, and securely lace back and forth a suitable piece of rope; this rope forms the body of the stretcher.

Accidents which may occur in diving.[1]—Diving is a serious undertaking, and should be so considered. Caution and attention should always be observed on the part of all who are connected with the operations.

Heretofore diving in the navy has practically been restricted to depths of 60 or 70 feet. In diving to this depth the ordinary physical standard as required was sufficient, but in deep diving the question of a more careful selection on account of liability to caisson disease is to be considered.

A careful examination by a medical officer is essential. A safe plan is to have all men examined by the medical officer before they are detailed for diving.

The accidents which may be encountered in diving operations are:

1. Asphyxia.
2. Squeeze.
3. Caisson disease.
4. Exhaustion.
5. Mechanical injuries from external violence.

Asphyxia.—The causes of asphyxia are insufficient or impure air supply and drowning. Manually-operated pumps do not furnish enough air for diving to any depth. Torpedo air flasks or a power compressor should be used to furnish air in depths over 100 feet.

In average figures the composition of the air in volume per cent is as follows:

Nitrogen	79.00
Oxygen	20.96
Carbon dioxide	.04

[1] Quotations from article by George R. W. French, P. A. Surg., U. S. N.

Expired air contains about as follows:

Nitrogen	79.64
Oxygen	16.02
Carbon dioxide	4.34

	N	O	CO_2
Inspired air	79.00	20.96	.04
Expired air	79.00	16.02	4.34
	00.00	4.94	4.34

That is, expired air loses 4.94 per cent of oxygen and gains 4.34 per cent of carbon dioxide.

If the percentage of CO_2 rises as a result of work, breathing must be increased to keep the percentage of CO_2 down. If as a result of rest the CO_2 percentage goes below 4.34 per cent, breathing diminishes.

The tendency is to keep the volume percentage of CO_2 in expired air at 4.34 per cent. In other words, no matter how much CO_2 is given off, the percentage volume of CO_2 in expired air is kept the same. The actual amount of increase of CO_2 given off during work is expelled by the breathing of a larger volume of air. Now if the air from the lungs mixes with the air supply in the diving helmet and increases the amount of CO_2 in the supplied air, it is necessary to breathe more air in order to keep the air in the lungs down to 4.34 per cent. If the air in the helmet contains 3 per cent CO_2 as a result of expired CO_2, the diver has to breathe twice as much air in order to keep the CO_2 per cent in his lungs down to normal.

If the CO_2 in the helmet gets above 4.34 per cent, it is impossible for the diver to dilute the CO_2 in his lungs, and he becomes asphyxiated. It will be seen from the foregoing that the nearer the supplied air is to pure the more easily will the diver be able to keep the CO_2 per cent in his lungs down to the normal standard.

Of course, it is absolutely impossible to keep the air in the helmet perfectly pure, but a standard of less than 3 per cent

CO_2 contamination must be adhered to, and at this point a very important fact can appropriately be brought out. The standard of 3 per cent CO_2 only holds good at normal atmospheric pressure.

It is found that what does remain constant is not the percentage, but the absolute pressure exercised by the CO_2. Example: $\frac{3 \text{ per cent } CO_2}{9 \text{ (atmospheres)}}$, or one third per cent of CO_2, would have the same effect on a diver in 264 feet of water as 3 per cent of CO_2 would at atmospheric pressure.

A diver at work produces .045 cubic feet of CO_2 per minute at normal pressure (15 pounds to the square inch).

The necessary standard of air supply is figured as follows:

D Delivery in cubic feet per minute of air required.

E No. cu. ft. of CO_2 expired per minute.

R Ratio of CO_2 desired.

If you want to find out how much air you must supply a diver under any given conditions, use the following formula:

$$D = \frac{E}{R} = D = \frac{.045}{.03} = 1.5 \text{ cu. ft. per minute.}$$

It must be remembered that this 1.5 cubic feet is measured at the pressure to which the dive is made. Measured at atmospheric pressure, in a dive made to 264 feet with $\frac{(264)}{(33)}$, or eight atmospheres excess, or nine absolute pressure, it is evident that air measured at the surface must equal 9×1.5 cu. ft., or a minimum delivery of 13.5 cu. ft. per minute to maintain a standard of 3 per cent CO_2.

Better ventilation than this is imperative for hard, useful work in diving; at least twice this delivery should be made.

The only real guide to air supply is the diver's well-being, but the above data are necessary as a basis on which to start.

As regards the purity of the air supplied to a diver:

In charging air flasks, be sure the air intake to pump is receiving its air from a pure source, and use no oil that volatilizes or smokes; use only castor oil for oiling diving pumps and air compressor pumps. As regards drowning, this will occur if the helmet becomes detached from the diving suit and is lifted off the head. Rupture of the suit will not cause drowning. It is only essential that the helmet remain over the head. Diving to over 100 feet can be done with helmet alone. The suit is only to protect the body and hold the helmet securely in place.

Squeeze.—Suppose a diver working at shallow depths should fall suddenly with no sudden ingress of compressed air into the suit. What would be the result?

The diver is working in a compressible dress and a rigid helmet so constructed that any increase of water pressure over air pressure within the helmet causes the regulating escape valve to seat, therefore no water can enter the helmet. Air is forced from the compressible dress into the non-compressible helmet, volume diminishing with increased pressure. If this volume of air does not fill the helmet and equalize the pressure of the water at the depth to which the diver has fallen, the extra pressure is exerted on the diver's body, tending to drive him into the helmet. The result is a serious injury or immediate death.

Falls from shallow depths to deeper depths are the most fatal, as the relative difference of pressure is greater. That is to say, a diver at the surface in 14.7 pounds pressure to the square inch (absolute) falls into water 33 feet deep; every square inch of his body has an additional pressure of 14.7 pounds, or 29.4 pounds absolute pressure to the square inch, or a proportion of two to one over the pressure in the helmet. As the body has a surface area of 2000 square inches, quite a few tons (14.7) pressure are exerted on the diver's body, driving him into the rigid helmet.

Falls from moderate depths to deeper depths are not as serious as falls from shallower depths; *i. e.*, in a fall from the surface to 33 feet the relative difference in pressure is two to one, while in a fall from 168 feet to 201 feet there would be a difference in pressure as 6 : 7, and the result would not be as serious.

Caisson disease.—This is caused by the liberation of gas bubbles in the blood and tissues. The gas in question is nitrogen gas absorbed by the body under pressure while diving and released when pressure is removed by the diver coming to the surface.

It is characterized by pains in the joints, paralysis, and, in severe cases, by death from heart failure.

According to the law of partial pressures, the volume of gas dissolved by a liquid varies directly as the pressure. As air is 80 per cent nitrogen and the oxygen combines with the blood in some way chemically, nitrogen is the only gas to be considered as a cause of caisson disease.

Now at normal atmospheric pressure the blood and tissues of the body absorb about one per cent of their volume of nitrogen gas. At two atmospheres pressure, or at 33 feet under the water, the blood and tissues absorb two per cent by volume of this gas, and so on, according to the law of partial pressures.

Ten atmospheres, or 330 feet under water, will cause the tissues to absorb ten per cent of their volume of nitrogen gas.

The accepted theory of the cause of caisson disease is that bubbles of nitrogen gas are liberated into the various tissues of the body, including the blood. The blood in the lungs, being in contact with the air, takes up nitrogen in physical solution. The circulation time of the blood has been calculated as one minute; hence the entire blood will be saturated for the given pressure of nitrogen in one minute.

If the blood were the only tissue of the body to be considered, it is evident that saturation and desaturation would take place in one minute, but such is not the case. The nitrogen in solution is given off to the various tissues and these, absorbing nitrogen, become saturated for the given pressure after a period of exposure of about four hours.

With a sudden decrease of pressure (high) to normal, it is evident that the nitrogen in solution at low pressure will be immediately liberated, as in the soda-water bottle, and form bubbles. Such is the case with the diver; but the bubbles are formed much more slowly, and it may take some hours to increase in size necessary to cause symptoms.

It is known that nitrogen is five times more soluble in fats than in the other tissues of the body. It is given off more slowly from the fats, and this accounts for the spinal cord lesions and lesions in the epiphysis of the bones, causing pains referable to joints in caisson disease. This also accounts for fat men being more predisposed to it.

Desaturation takes place at the same rate as saturation; hence, if it takes four hours for a man to saturate for a given pressure, it will take four hours for him to desaturate.

It has been found that a man can become saturated for one atmosphere excess pressure and have pressure immediately reduced to normal without any ill effects whatsoever. In fact, a little higher pressure than this can be stood; *i. e.*, saturation at 2.3 absolute pressure and decompressed to atmospheric pressure, or a ratio of two and three-tenths to one. It is considered that the bubbles of nitrogen that are liberated are so fine as to pass through the finest capillaries and cause no damage or danger to the diver's well-being. On this theory has been constructed a series of tables, based on what is known as stage decompression (in contrast to slow or uniform decompression); that is, a change of absolute pressure to a reduced pressure, so that absolute pressure will be to this reduced absolute pressure as two to one, or two and three-tenths

to one. Example: A diver is working at 165 feet, or five atmospheres excess pressure, or six atmospheres absolute. According to this theory, absolute pressure can be immediately diminished to two and six-tenths atmospheres; *i. e.*, six to two and six-tenths equals two and three-tenths to one.

As we have the atmosphere exerting one atmosphere pressure, the diver can be safely brought up to an excess pressure of one and three-tenths atmospheres, a depth from the surface

DIVING TABLE.

Depth of dive in feet.	Time under water surface to beginning of ascent.	Stoppage in minutes at different depths. Feet.								Total time for ascent in minutes.
		80	70	60	50	40	30	20	10	
36 to 54..	Over half hour........	....	....	....	....	....	....	....	20	20
54 to 72..	Half to two hours.....	....	....	....	....	....	....	10	20	30
72 to 84..	Half to one hour......	....	....	....	....	....	....	10	20	30
84 to 96..	20 min. to one hour...	....	....	....	....	....	5	10	15	30
96 to 120..	15 min. to half hour...	....	....	....	....	....	5	10	15	30
120 to 156..	10 to 20 minutes.......	....	....	....	2	3	5	8	10	28
156 to 180..	10 to 15 minutes.......	....	....	....	2	3	5	7	10	27
180 to 204..	Up to 12 minutes......	....	....	2	2	3	5	7	10	29

WHEN UNDER WATER FOR LONG TIME.

50 to 100..	Over two hours.......	....	....	....	....	15	30	35	40	120
100 to 150..	Over one hour.........	....	....	20	25	30	35	40	40	190
160 to 200..	Over one hour.........	15	20	25	30	30	35	40	40	235

of 43 feet. Upon this theory there has been constructed an excellent system of tables, the man coming quickly from deep and dangerous pressures to comparatively shallow depths with the various stops at every ten feet.

For deeper depths correspondingly longer decompression periods must be used, and a recompression chamber should be at hand in order to place the diver under pressure again if he develops symptoms of caisson disease.

Exhaustion as a result of efforts to become released when fouled and due to hard work often occurs. Deaths from exhaustion in diving have occurred.

Mechanical.—Injuries may occur as a result of getting caught between heavy objects under water set in motion by currents.

Accidents peculiar to submarines.—These are due to pollution of the contained air from various sources.

1. Pollution by breathing of crew.
2. By fuel oil fumes.
3. By batteries.
4. By smoke and irritating gases of burned insulation in case of a short circuit.
5. By air from the banks, where these have been carelessly charged with impure air.

Pollution by breathing of crew.—If a submarine remains submerged for a very long period for any reason, there will be a steady increase of carbon dioxide in the contained air, caused by the exhalation of the crew. There will also be a diminution of the oxygen.

The former is by far the more important, as ill effects from excess of carbon dioxide will be experienced long before the oxygen has become low enough to cause any symptoms.

The effects of carbon dioxide in excess are: Labored breathing, headache, dizziness, drowsiness, and finally loss of consciousness. Men are less active mentally and physically as the carbon dioxide percentage in the air increases.

When carbon dioxide reaches three per cent in a compartment (submarine submerged), marked symptoms develop, and the addition of oxygen, even in excess of that found in ordinary air, will not relieve the condition. Over five per cent carbon dioxide will cause rapid asphyxiation.

Two per cent is the permissible limit of carbon dioxide in a submarine. This is an arbitrary standard, but from present knowledge seems reasonable.

After the initial air (that already in the submarine) is contaminated by the crew so that it contains two per cent of

expired carbon dioxide, thirty-five cubic feet of fresh air per man per hour must be added to keep the carbon dioxide from going over two per cent.

The oxygen should not be allowed to go below fifteen per cent. This would require that when the air had been reduced to that percentage, about one cubic foot of pure oxygen, or five cubic feet of pure air, be added per man per hour; but as you are obliged to add thirty-five cubic feet of air per man per hour to keep the carbon dioxide down to two per cent, this will be well provided for where you are keeping the air up to standard by adding fresh air; but in case you use some form of air regenerator, which removes the carbon dioxide without adding anything, oxygen will have to be supplied at the rate of one cubic foot per man per hour.

There are two ways of keeping the air up to the required standard: one by adding fresh air, and the other by extracting the carbon dioxide by circulating the air over some chemical solution which absorbs it, and adding enough oxygen to keep up the fifteen per cent standard.

Fresh air can be added from the banks or air flasks, which carry air compressed to twenty-five hundred pounds to the square inch. There is more than enough air in the banks for one complete filling of the whole submarine, but only fifty per cent of it can be used for freshening the polluted air in the submarine; fifty per cent has to be reserved for blowing tanks, etc., which have to do with increasing buoyancy and coming to the surface.

If air from the compressed air flasks is liberated into the submarine compartments, it dilutes the pollution therein and supplies more oxygen, but it is like running fresh water into a basin containing ink. If you want clean water in the basin you must first empty the basin and then supply the clean water. If you want clean air in the submarine you must first empty the submarine and then supply the clean air. This is not

possible when submerged, but it is possible to give each man clean air out of the banks by supplying each man with a face mask, gas bag and small rubber tube, which can quickly and easily be attached to pipes from the air banks. This is by far the most economical way of using air from the banks; and as, in an emergency which keeps a submarine in prolonged submergence, asphyxiation by impure air will be the danger, economy in its use is of first importance.

The chemicals having the power of extracting carbon dioxide from the air are:

1. Potassium hydrate, best and most easily handled.
2. Sodium hydrate, good.
3. Lime, freshly slacked and before exposure to air.
4. Sodium peroxide, which gives off oxygen at the same time, and would seem ideal; but it is very hard and dangerous to handle.

Potassium hydrate seems to be the chemical of choice, as it is efficient and the most easily handled.

Lime is the chemical of choice if a method of bringing it into contact with the air can be devised.

All of these chemicals will extract chlorine, sulphuric acid fumes, and odors due to organic impurities. They will not extract either carbon monoxide, or hydrogen.

Air-purifying machines consist of a box or compartment in which the chemical which absorbs carbon dioxide is contained, and an electric fan which circulates the air over the chemical solution. There are, of course, various different designs, the idea being to get as large a surface as possible in order to bring as big a volume of air in contact with the extracting solution as possible.

Pollution by fuel oil fumes.—This occurs in the engine room in the form of smoke. The prolonged inhalation of this smoke or partly oxidized fuel oil produces symptoms of headache, dizziness, very weak and rapid pulse, cold, clammy skin,

and loss of consciousness. Treatment consists in immediate removal to a place where the air is pure, application of hot-water bottles and blankets, and keeping patient in bed for a day or two. If taken in time recovery usually follows quickly.

These same symptoms will occur when a man breathes the raw fumes of fuel oil, as when working in fuel oil tanks. While working in a fuel oil tank a man may become unconscious, and, unless some one is at hand to remove him, he may be so badly poisoned that he will not recover. While working in tanks a man should have a breathing mask with a tube connecting him with some source of fresh air supply, such as the banks.

Pollution by the batteries.—Batteries of the old form are constantly giving off sulphuric acid spray; those of the new form, sodium hydrate spray. These are very irritating to the throat and lungs, but do not cause any serious symptoms. The great source of danger has been the formation of chlorine gas, the symptoms it causes having been previously given. The trench masks carried in the pocket or conveniently placed about the boat might be a good precaution.

The treatment has been given.

Short circuits with burning insulation may cause suffocation. Remove to source of pure air.

Pollution of contained air by air from banks which have been carelessly charged.—Great care should be exercised to see that no bad air is ever pumped into the banks.

No submarine should be allowed to charge the air banks except by using the electric motors to run the compressors; and at no time charge air while the engines are running. Also, extreme care should be taken that the exhaust engine gases of a boat lying alongside are not blowing across the vessel and being drawn down into the engine room.

CHAPTER X.

ALCOHOL AND OTHER NARCOTICS.

Nothing in nature, so far as we know, is at a complete standstill. There is a law which decrees unalterably that there must be growth or decay—progress or deterioration. The pyramids have stood for centuries and probably will stand for centuries to come; but, although the process may be slow if left to time alone, even they will eventually crumble and be destroyed. Man is no exception to this rule; he must develop his physical strength by a proper amount of exercise, or he will lose that strength. He must cultivate his mental faculties and develop them, or he will lose them. His moral nature must be built up, strengthened, and developed, or he will sink into a condition of degeneration. As far as religion and morality are concerned, it is well known that a man really never begins to progress until he realizes how sinful he is. The intellectual man is appalled, not by the amount of information which he has, but by the number of things which he does not know. It is this feeling of discontent which seems to be inherent that is responsible for the advance which is constantly being made. The true artist is rarely satisfied with his own work, and is ever striving to outdo himself. It is the same with the writer who sees flaws in his productions, and the business man who never ceases to strive to increase his business, to extend its scope, and to add to his wealth. These are the means by which the mental, moral, and physical man is developed as he progresses nearer and nearer to perfection.

With the coinage of money it became possible for men to accumulate not merely desirable commodities themselves, but that which made them powerful, enabled them to command

the services of others, and gratify ambition and vanity. In every part of the world the accumulation of great wealth by a people has been followed by a wave of luxury and extravagance, which state undermined and destroyed the healthful emulation, the energy and ambition which strengthened and developed them as a nation and as individuals. Luxury takes the place of proper living; indolence supplants energy and ambition; self-indulgence destroys the will and leaves the man in a condition of degeneracy which makes him the victim of ennui and susceptible to evil influences through weakness and through a sated appetite, which causes him to constantly seek and welcome "new sensations." So it is at the present day. We find men and women not satisfied to feel as normal men and women feel and who, therefore, turn to various substances for exhilaration, stimulation, sedation, or some sensation not normal, but artificial and unnatural. Normal men and women must assume whatever burden they are called upon to bear, but at the present time there is a large class who seek to shift those burdens by placing themselves in a condition of entire irresponsibility. The drunkard and the drug users are the most prominent examples. No one is born with a craving for liquor or drugs; years ago that theory was exploded. But modern living is responsible for many ailments and conditions which accentuate inherent weakness in both men and women and cause them to travel over dangerous roads.

Alcohol.—The drinker almost invariably acquires his addiction in the pursuit of so-called pleasure. His desire to be a "good fellow," his fondness for company, his generosity and popularity all tend to increase his circle of drinking acquaintances and the quantity of alcoholic stimulants he takes; but while he is acquiring his addiction he is having what he considers "a good time" and "being social."

Why do men drink to excess?—This is a question which is often discussed, particularly in relation to its bearing on indi-

vidual cases. People who do not drink to excess themselves pass judgment on a case hastily, and usually end by blaming the man. The person who argues thus usually has in mind the case of some one who has been advised not to drink and who stops, and the argument, therefore, is that if one man can stop, why cannot another if he desires to do so? A more careful investigation, however, will show that this kind of reasoning is fallacious.

It may be asked, Why is it impossible for one man to do that which another finds possible? Some argue it must be a weakness, lack of will power, or something of that kind. This also is an incorrect answer. The men who become addicted to drink, the history of the world shows, have often been much above the average, sometimes reaching great intellectual and physical heights. No two men are exactly alike. No one has been able to answer satisfactorily the question why it is that poison ivy poisons one man and does not poison another; why it is that quinine should not be administered to some patients while it can be safely administered to a large majority of people. Why is it that shellfish poison some people and do not poison others? It is the knowledge of these facts and their existence which makes the old saying, "What is one man's food is another man's poison," absolutely a truth. The men we are talking about are men who have nervous systems which are peculiarly susceptible to the poison of alcohol; they do not discover this until it is too late. The reason that they do not stop drinking then is because the disease stage has been reached before they know it. They have acquired the drinking habit while being good fellows, and they cannot stop.

Many a young man has taken his first drink against his conscience and early training because he wanted to be considered a "broad man," a "good fellow."

The chemical composition of alcohol.—Alcohol belongs to a class of chemical substances formed from hydrocarbons by the

replacement of one or more hydrogen atoms by hydroxyl (OH). There are many different alcohols, some of which are poison, as, for instance, wood alcohol or methyl alcohol.

When the term alcohol is used without qualification, it refers to ethyl alcohol—C_2H_6O ($CH_3.CH_2.OH$)—which is the alcohol that occurs in the common forms of alcoholic drinks. Ethyl alcohol is produced by a process of fermentation. An air-borne microscopic plant called the yeast plant produces a ferment which acts on sugars, splitting them up into alcohol and carbon dioxide.

These sugars occur in various grains, fruits, and vegetables; in fact, most all plants contain starch and sugar which can be converted into alcohol by the action of the yeast plant.

In any particular solution, this process of fermentation cannot go any further after the alcoholic content reaches about 15 per cent, as the yeast plant ceases to act in a solution of this strength or stronger. In order to get a stronger solution of alcohol the process of distillation has to be used.

We then have two principal varieties of liquors: the stronger or distilled spirits, and the weaker, below 15 per cent, or fermented spirits.

The alcoholic liquors are:

1. Wine, made by the fermentation of fruit juices.
2. Malt liquors, by the fermentation of malt.
3. Distilled spirits, which are made by successive vaporizations and condensations of the 15 per cent product of fermentation.

To these it might be well to add the various patent medicines, tonics, bitters, and nerve stimulants which depend for their action on the alcohol that they contain.

The effects of alcohol on the body.—*Nervous system:* Alcohol has a peculiar affinity for the nervous tissues, which it first excites or irritates, then paralyzes, and later destroys. Its irritant quality is shown by the excitant action it causes

on the nerve centers in the brain and spinal cord. This excitant action shows itself first on the higher centers of the brain, which have to do with judgment, self-control, reasoning power, etc., disturbing their balance and proper relation with each other, so that even after the first drink the mind does not functionate normally; it may functionate more rapidly, but the proper balance is disturbed, and it will be noticed that although the man seems about the same, there is a change. He will be more assertive, less sensitive to the feelings of others, and he will have a tendency to talk more than usual and in a more egotistical manner. In the case of the man who has been in the habit of drinking, these first mild symptoms will be suppressed or inhibited, for past experience has taught him that after a drink or two some of his senses will be abnormally excited. Drinkers cultivate this inhibitory power, but, although they can keep from showing the effects of a small quantity of alcohol, they cannot prevent its destructive action on the nerve centers.

If a man takes a large number of drinks his nerve centers are completely paralyzed, and he will not be able to think or to move his muscles; if he takes a very large number of drinks he may produce paralysis of the heart and death.

After a drinking bout the system apparently returns to normal, but this is only apparently, for in reality after every dose of alcohol there is left some permanent damage to the body; it may be an organic change shown by the death of one or more cells, or simply a functional change, evidenced by more easily excited nerves with some slight change in the heart's action.

Digestive system: A drink or two before meals will increase the appetite, but not the digestive power of the stomach, so that a man eats more than he can assimilate. A couple of cocktails before dinner means a stomach overloaded with food which it cannot digest. This undigested food undergoes fer-

mentation and, instead of being a source of nourishment to the body, becomes an irritant to the stomach and intestines, and the poisonous products formed by its decomposition are absorbed into the system and have a poisonous action on the various tissues of the body.

Heart and blood vessels: It is well known that the prolonged use of alcohol, even in small quantities, produces degenerative changes and functional disturbances of the heart and arteries. After a drink or two there is a brief rise in blood pressure, with a flush of the skin, which gives the impression of being warmer, and a general feeling of well-being; but there is in reality, owing to increased radiation from the skin, a lowering of body temperature with an increased tendency to catch cold. Drunkards are peculiarly susceptible to pneumonia and freezing. Alcohol should never be given to prevent freezing, as it has the opposite effect. In fact, it is only good after the subject has come in out of the cold and is ready to take a hot bath and cover up warmly in a sheltered place, and even here its only use is to give a sense of comfort and well-being.

Kidneys: These organs excrete the waste products of the body. Alcohol has a doubly damaging effect on the kidneys, as it increases their work by increasing the amount of waste products to be excreted, *i. e.,* the toxins absorbed from the intestines from undigested food; and it has a direct irritant action on these organs as it is excreted by them.

General effects: Recent investigators are very generally of the opinion that alcohol reduces vitality and the power to resist disease.

It has been found that animals fed on small quantities of alcohol for a few months were less resistant to disease and were more susceptible to poisons.

Experiments on human beings to show quickness of coordination, memory, reason, etc., prove that these are all interfered with by even small doses of alcohol.

1. Test for coordination: Flash red light, time taken to turn off throttle and put on brakes. Man without having taken alcohol fraction of minute quicker than same man after small drink.

2. Test for memory: Memorize words, figures, etc. Man after drink much less efficient.

3. Test for reason: Problem to solve. Done much quicker by man without drink.

The food value of alcohol: It has so little that it cannot be classed as a food; only a small part of that taken into the system is oxidized, the most of it being excreted unchanged by the lungs and kidneys. If any of it is oxidized, furnishing heat and energy to the body, the damage that it does by its irritant action on the various tissues more than neutralizes any beneficial action it may have.

Alcohol as a medicine: As an aid to digestion its use cannot be recommended, as it creates a false appetite, which induces the subject to take more food than the digestive tract can handle, thus leaving a fermenting irritant mass in the stomach and intestines to further increase his digestive troubles. Alcohol will not only not cure digestive troubles, but it will make them worse.

As a stimulant, alcohol only has a very temporary action, which is followed by a period of depression more than offsetting stimulation.

Poisonous effects: The term poison means any substance which kills tissue or impairs function. Under this definition alcohol is a poison, for, as before stated, it first deranges the functions of the various organs of the body, and its continued use destroys them. Of course, poison is a relative term. You may say over-indulgence in food produces interference with function and degenerative changes; but alcohol, in any quantity, if long continued, will produce evil effects, and any good that can be derived from it is more than counterbalanced by the harm it does.

Effects on longevity: The Equitable Life Insurance Company has published a statement to the effect that the death rate among the moderate consumers of liquor is twenty-three per cent higher than among total abstainers, and some of the life insurance companies put abstainers in a separate class among their policyholders, making them a special allowance of five per cent or more on their premiums.

There has been a marked change in sentiment in late years with reference to alcohol. The number of total abstainers has increased, and in our army and navy the use of alcohol is steadily lessening, and has been for a number of years past.

A regulation (borrowed from the British Military Law) used to be adhered to in our army, that of adjourning courts-martial at 3 p. m., "since no gentleman was expected to be sober after that hour," and the navy used to have its regular daily ration of grog.

Military considerations: The opinion of military experts all over the world is that alcohol is conducive to inefficiency and that it leads to a large number of punishments and loss of time from having officers continually sitting on courts-martial cases.

Careful experiments conducted in Sweden showed that after one drink of brandy marksmen made forty per cent fewer hits.

The solution of the liquor problem seems not to be in legislation, prohibition, higher license, or local option, but rests in the general education of the public as to its harmful effects.

Alcohol is never necessary, and usually undesirable. It does not increase power or capacity to do work. It does not increase endurance, and it renders a person more liable to the effects of cold. It renders a man's mind less active, and thus causes him to make mistakes which at times lead to serious consequences.

It leads to the formation of the habit, with resultant evils to the individual and to society.

Habit-forming drugs.—Opium and its derivatives are the drugs most commonly used by addicts. Morphine is the most common, but of late years many new forms are coming to the front. Among the latter may be mentioned codeine and heroin. Each has its place and probably its merits in proper cases, but each is dangerous when its use is continued long enough to create a demand for it. There are also other drugs to which people become addicted, such as chloral hydrate, cocaine, bromides, chloroform, etc. These substances will not be considered separately and in detail in this chapter for want of space. When reference is made to "drug," "morphine," or "opium," these terms, so far as the addiction is concerned, may be considered to include all the others. There are differences, but the differences are details, and this classification is sufficient and, when understood, is not misleading.

Opium is a substance which, rightfully used, is capable of being of great use to humanity. Administered properly to those suffering intense pain, the nervous system is relieved, sleep is induced, and the patient, by the relief afforded, is placed in a condition to battle once more with his malady. Administered by the conscientious physician, opium is a blessing, but used indiscriminately, ignorantly, carelessly and, as it sometimes is, viciously, it can be turned from a blessing into the greatest curse with which humanity is afflicted, with the possible exception of alcohol. There is a theory that pleasurable sensations are obtained by the use of opium, and many writers of fiction have placed before the young stories of this kind which have no real existence except in the imagination of the writer. One book giving the experience of an opium user, written in 1821, is still a classic and is found in every well-equipped library. It may be said in passing that there is nearly as much fiction in De Quincey's "Confessions of an Opium-Eater" as there is in a novel, at least as far as the description of the splendid dreams, pleasant sensations, and

the grandeur of the vistas the drug opens up is concerned. Because opium produces sleep when one is troubled with insomnia, because opium deadens pain and temporarily relieves suffering, because it blunts the acuteness of mental suffering and makes one for the time being oblivious to sorrow, it can be said to produce pleasurable sensations, but in no other way. The healthy man or woman gets no pleasure from the use of opium in any form. Its effects are exceedingly disagreeable, and the after effects decidedly disastrous. Some people in normal health have persisted in using it, endeavoring to find the pleasurable sensations they have read of, only to find when they seek to abandon the habit that it is impossible to give it up. Some begin its use through curiosity, some, as we have said, looking for the pleasurable sensations; others acquire the habit through continuing the use of a prescription, harmless when taken according to directions, but dangerous when long continued. For these and many other reasons people begin and continue its use. By far the larger number of opium addicts, however, begin on account of sickness or injury. These people, as a rule, are in such a physical condition that its use is necessary for the relief of pain. In fact, the patient often has no volition in the matter, and does not know what is being administered to him. If the condition of pain or suffering is continued long enough, he becomes an opium addict unconsciously and of necessity. The opium user has no pleasant road to travel in acquiring his addiction. There is no hilarity in becoming an opium addict; there is no good fellowship, no boastfulness, no fictitious courage, no generosity, no sumptuous barrooms or buffets to please his eye or draw together those of similar tastes. He takes his dose in secret, sometimes displaying the utmost cunning and ingenuity to conceal his addiction from even his best and most intimate friends; and meanwhile he is not only undermining his constitution and destroying his capacity for rational enjoyment, but

also removing the foundation upon which rest health, will, mentality, and character.

It is almost impossible, even if it were desirable, to describe the condition of the opium user when he finally realizes he cannot abandon the habit. At the beginning he had false confidence based upon his belief in his own strength. Later he is appalled by his weakness and dependence. Even when he finds he has to take the drug two, three, and four times a day in order to have a reasonable degree of comfort, he still believes that some course will be opened to him by which he will be able to discontinue its use—just what, he does not know; he evades even thinking of the subject, seeking forgetfulness in increased doses. There is no slavery, and never has been any, equal to that of morphine. The remorse and the hopelessness of the bondage are humiliating enough, but in addition there is a train of collateral troubles. Functional activity of almost every kind is lessened, and there is a train of distressing symptoms in consequence which furnishes the addict with a plausible excuse for indulgence. The intellect is warped and clouded, consecutive and rational thought is impossible, the moral nature is changed and perverted; the patient becomes morose, unsociable, does not desire to make new acquaintances, even seeks to avoid meeting old ones, while in the bosom of his family he becomes sullen and depressed and exercises a constant watchfulness lest he disclose the nature of his trouble or, if it be known, give fresh food for remonstrance on the subject.

Every man and woman, as we have said, is called upon to bear some pain, some sorrow, some inconvenience, and the qualities which are exercised in enduring these develop the character of the individual. The man or woman who persistently evades the exercise of these qualities soon loses them. Every faculty, whether physical or mental, has to be exercised in order to keep it in a sound condition, and the faculty of

endurance is no exception. If one evades exercising this faculty for any great length of time, he will find when he undertakes to use it that it is atrophied and lost to him.

Tobacco.—Tobacco is more widely used than any other narcotic. Its devotees claim that it is entirely without ill effects, while a large number of people denounce it as wholly pernicious. Many good authorities have said that man would be better off without the use of any form of narcotics, and this is undoubtedly true; it is certainly true for those under age of complete development, which age is in the majority of cases several years past twenty-one.

Nicotine is the alkaloid in tobacco. It is a powerful poison, which will produce death when given in even very small doses. It, like the other narcotics, induces the habit, and it is one of the hardest habits to break.

Nicotine is a depressant poison, which causes functional derangement of the nervous system, disturbances of the special senses and digestive system, and hypertrophy and irregularity of the heart. No adolescent can stand the strain that it places on the system, as shown by the retardation in growth, idleness, lack of ambition, and low scholarship among college boys who smoke.